JPRS 84161

22 August 1983

USSR Report

SPACE

No. 24

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and characteristics retained.

Headlines, editorial reports, and material enclosed in brackets are supplied by JPRS. Processing indicators such as (Text) or (Excerpt) in the first line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U. S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U. S. Government Publications issued by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Indexes to this report (by keyword, author, personal names, title and series) are available through Bell & Howell, Old Mansfield Road, Wooster, Ohio, 44691.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS REPORTS

Japan Report
Korean Affairs Report
Southeast Asia Report
Mongolia Report

Near East/South Asia Report
Sub-Saharan Africa Report
West Europe Report
West Europe Report: Science and Technology

Latin America Report

USSR

Political and Sociological Affairs
Problems of the Far East
Science and Technology Policy
Sociological Studies
Translations from KOMMUNIST
USA: Economics, Politics, Ideology
World Economy and International Relations
Agriculture
Construction and Related Industries
Consumer Goods and Domestic Trade
Economic Affairs
Energy
Human Resources
International Economic Relations
Transportation

Physics and Mathmetics
Space
Space Biology and Aerospace Medicine
Military Affairs
Chemistry
Cybernetics, Computers and Automation Technology
Earth Sciences
Electronics and Electrical Engineering
Engineering and Equipment
Machine Tools and Metal-Working Equipment
Life Sciences: Biomedical and Behavioral Sciences
Life Sciences: Effects of Nonionizing Electromagnetic Radiation
Materials Science and Metallurgy
Meteorology and Hydrology

EASTERN EUROPE

Political, Sociological and Military Affairs
Scientific Affairs

Economic and Industrial Affairs

CHINA

Political, Sociological and Military Affairs
Economic Affairs
Science and Technology

RED FLAG
Agriculture
Plant and Installation Data

WORLDWIDE

Telecommunications Policy, Research and Development
Nuclear Development and Proliferation

Epidemiology

FBIS DAILY REPORT

China
Soviet Union
South Asia
Asia and Pacific

Eastern Europe
Western Europe
Latin America
Middle East and Africa

To order, see inside front cover

JPRS 84161

22 August 1983

USSR REPORT

SPACE

No. 24

CONTENTS

MANNED MISSION HIGHLIGHTS

MANNED FLIGHT CHRONOLOGY

[Editorial Report] The Soviet News Agency TASS reports the following information on activities connected with manned spaceflight activity.

27 Jun 83 - Launch of "Soyuz T-9"

In accordance with the program for space research the "Soyuz T-9" spacecraft was launched in the Soviet Union at 1312 hours Moscow time on 27 June. The crew consists of ship commander Vladimir Afanas'yevich Lyakhov and flight engineer Aleksandr Pavlovich Aleksandrov. The flight program calls for docking with the "Salyut-7"--"Cosmos-1443" orbital complex. The crew will perform scientific-technical and medical-biological studies and experiments aboard the manned complex. (Moscow PRAVDA in Russian 28 Jun 83 p 1)

28 Jun 83 - Docking with "Salyut-7"--"Cosmos-1443"

At 1446 hours Moscow time on 28 June the "Soyuz T-9" docked with the "Salyut-7"--"Cosmos-1443" complex. After checking the docking seal, the cosmonauts entered the station. Total weight of the "Salyut-7"--"Soyuz T-9"--"Cosmos-1443" complex is 47 tons. The crew's work program includes:

-- astrophysical and medical-biological research
-- technological and technical experiments
-- development of control methods for large-dimension manned orbital complexes.

(Moscow PRAVDA in Russian 29 Jun 83 p 2)

29 Jun 83 - Cosmonauts' Second Day in Orbit

Orbital parameters of the complex are: apogee, 343 kilometers; perigee, 328 kilometers; period of revolution, 91.1 minutes; inclination, 51.6 degrees. The cosmonauts' second day began at 1000 hours Moscow time and will last until 2300 hours. The cosmonauts are preparing the station for manned flight. In particular, they are reactivating the life support and thermal regulation systems and checking radio communication equipment. In the living sections of the complex the pressure is 750 mm Hg; temperature is 18°C. The cosmonauts' adaptation to weightlessness is proceeding normally. (Moscow PRAVDA in Russian 30 Jun 83 p 1)

30 Jun 83 - Opening of "Cosmos-1443" Hatch

The cosmonauts are continuing to reactivate "Salyut-7". Today they checked the orientation system and the control panels and inspected the station's viewports. The cosmonauts opened the hatch of "Cosmos-1443" today. "Cosmos-1443" carries about 3 tons of cargo, including apparatus for scientific experiments and crew life support equipment. Unloading of "Cosmos-1443" will begin tomorrow. (Moscow PRAVDA in Russian 1 Jul 83 p 1)

1 Jul 83 - Unloading of "Cosmos-1443" Begins

Cosmonauts Lyakhov and Aleksandrov are in their fourth day aboard the complex. They have begun unloading "Cosmos-1443". The cosmonauts have placed film in the hand-held cameras and have turned on the "Astra-1" mass spectrometer apparatus. Today the crew opened the hatch and examined the return module of "Cosmos-1443". The return craft can bring back to earth up to 500 kilograms of material. Today's schedule also includes physical exercise and a television report. (Moscow PRAVDA in Russian 2 Jul 83 p 1)

5 Jul 83 - Second Week in Orbit

Cosmonauts Lyakhov and Aleksandrov are in their second week aboard the complex. They are continuing to reactivate the station and unload "Cosmos-1443". They are taking an inventory of food supplies, replacement gear and other expendables. As part of the regular maintenance plan, today the crew will replace a filter in one of the station's gas analyzers and install a new unit in the system for regeneration of water from atmospheric moisture. Tomorrow the cosmonauts will prepare the stationary cameras for operation and check radio communication equipment. (Moscow PRAVDA in Russian 6 Jul 83 p 1)

8 Jul 83 - Visual Observations, Photography

In the past few days the cosmonauts have prepared for operation the KATE-140 and MKF-6 cameras and have checked their operation. The flight program includes a large number of studies in the interests of various scientific and national economic tasks. Today the crew began a series of visual and instrumental observations and photography of territory of the USSR, including regions of the Caucasus, north Caspian, Gornyy Altay and Primorskiy Kray. Geophysical studies will continue tomorrow. (Moscow PRAVDA in Russian 9 Jul 83 p 1)

15 Jul 83 - First Survey Completed, Medical Exam

Yesterday the crew completed the first series of complex studies of the earth's surface. The photosurvey covered a large area of the USSR in the middle and southern latitudes. In addition to cameras the cosmonauts used the Bulgarian "Spektr-15" instrument and the MKS-M spectrometer, developed by GDR specialists. The "Yelena" gamma telescope has been turned on to study streams of gamma

radiation and charged particles in near-earth space. In addition to their scientific work the cosmonauts are continuing to unload "Cosmos-1443" and stow the instruments and equipment. Today the crew is engaged in scheduled maintenance and checkouts of onboard equipment. As usual, physical exercise is part of the daily schedule. A few days ago a complex medical study of the crew was performed. This included study of cardiac bioelectric activity at rest and cardiovascular system reaction to simulated hydrostatic pressure. Both cosmonauts are healthy and feel well. (Moscow PRAVDA in Russian 16 Jul 83 p 1)

22 Jul 83 - Cosmonauts Pass 25-Day Mark

During the past days the cosmonauts have collected data on agricultural conditions in the Volga region, north Caspian area, Central Chernozem, the Caucasus, Central Asia and other areas. Today the crew is completing the cycle of comprehensive studies of the earth's surface which was begun on 18 July. Yesterday the cosmonauts underwent a medical check. In particular, cardiovascular reaction was studied while the cosmonauts exercised on the bicycle-ergometer. The commander's pulse rate is 57 beats per minute, the flight engineer's is 58; their arterial pressures are 130/59 and 130/60 mm Hg, respectively. (Moscow IZVESTIYA in Russian 23 Jul 83 p 1)

CSO: 1866/169-P

CAPABILITIES OF 'COSMOS-1443' CRAFT DESCRIBED

Moscow PRAVDA in Russian 3 Jul 83 p 3

[Article by candidate of technical sciences D. Alekseyev: "A New Element for the Complexes: 'Salyut-7'--'Cosmos-1443'--'Soyuz T-9'"]

> [Text] Vladimir Lyakhov and Aleksandr Aleksandrov are now living in a space home the like of which cosmonuats have not previously inhabited. The "Soyuz T-9"--"Salyut-7"--"Cosmos-1443" scientific research complex is now operating in manned mode in orbit round the Earth. The total weight of this space "linkup" is 47 tons, and it is almost 35 meters long. Its new element is the vehicle-satellite "Cosmo-1443." What prompted its development and use in space missions?

Orbital complexes constitute the main direction in Soviet cosmonautics for scientific research in near-earth space. Their operation requires regular replenishment of life-support products used by the crews, fuel, and various kinds of scientific apparatus and other useful freight. Expanding the possibilities and improving results from experiments aboard the orbital complex have become possible thanks primarily to improvements in the transportation element.

The "Progress" freighters have recommended themselves well. They supply crews with all they need for normal life and work beyond the Earth. However, in order to develop large orbital complexes, other vehicles are also essential. They include the "Cosmos-1443" artificial Earth satellite launched on 2 March 1983.

Before a new space vehicle takes its place in the space programs much preparatory work must be done, including an essential check of its flight qualities. The specialists say that each machine requires running tests. For the "Cosmos-1443" these were initiated on 17 July 1977 when the "Cosmos-929" was launched. After a 201-day flight, after having fulfilled the program, on command from Earth it ceased to exist. The next stage of development started on 25 April 1981 with the launch of "Cosmos-1267." On 19 June 1981 the "Salyut-6"--"Cosmos-1267" scientific research complex was created in near-earth orbit.

From the moment of docking "Cosmos-1267" assumed control of movement of the orbital complex and its orientation and stabilization. With the aid of its combined propulsion system several dozen dynamic operations were carried out and the orbit of the complex was raised three times. Linked up with the "Salyut-6" the new vehicle-satellite was tested in fact as a space tug.

And finally, on 10 March 1983 the "Salyut-7"--"Cosmos-1443" orbital complex started operations in automatic mode.

Using the "Cosmos-1443" propulsion system, orbital corrections to the complex have been made six times and a large number of dynamic operations have been carried out. On 23 June a correction impulse was made to insure docking with the "Soyuz T-9."

The flight program for the "Soyuz T-9"--"Salyut-7"--"Cosmos-1443" system provides for a whole series of scientific research and experiments during which the "Cosmos-1443" will insure the necessary orientation and stabilization of the complex.

And what is the new vehicle like? Its total weight in orbit with payload exceeds 20 tons; it is more than 13 meters long. The vehicle's diameter in the wide section is more than 4 meters, and the span of the solar batteries is 16 meters. The total area of the photocells is 40 square meters.

The new vehicle-satellite was designed as a multipurpose space vehicle. When developing it the designers made use of the rich experience gained during the course of work on the "Salyut"-type stations. Today, we can say that the new space vehicle has two functions, namely freighter and space tug.

"Cosmos-1443" was made in the freighter version. The vehicle consists of an orbital assembly and a vehicle for returning freight. Its onboard systems insure both automatic flight and flight as part of a complex. The control system includes independent duplicate digital and analogue circuits. When operating in automatic mode, using the onboard computer complex the vehicle's systems help to diagnose the function of onboard units and mechanisms and find ways out of unforeseen situations. The vehicle carries out dynamic operations and changes orbit with great accuracy.

Even though the size of the "Salyut" stations is not insignificant, crews have nevertheless said that it would not be a bad idea to increase the "space living area." The new freighter makes it possible to do that already today. Its systems maintain a constant gas composition and regulate temperature, and the life-support systems create normal conditions for the cosmonauts.

The vehicle's reentry section is equipped with braking engines and systems that insure its independent flight, controlled descent and soft landing. It is designed to deliver a payload of about 500 kilograms to Earth, in particular results from studies conducted aboard the complex.

The flight program for the "Cosmos-1443" as part of the scientific research complex provides for further tests of its onboard systems, units and design

elements and working on methods for controlling orbital "linkups" of large size and mass. "Cosmos-1443" delivered to orbit containers with food, water and air, replacement units and assemblies for service systems on the station, movie and photographic materials and more than 600 designated items of payload.

For convenience in storing and loading and unloading, most of the materials carried by the "Cosmos-1443" are packed in containers stacked along the sides of the vehicle. Special trolleys that move along guides set in the passageway facilitate the cosmonauts' work.

The design version of the vehicle used for this flight is by no means the only one. The vehicle-satellite of this type can serve, in particular, as the basis for elements of orbital modules for various purposes (scientific, production and so forth). Soviet cosmonautics has got close to the development of specialized modules each of which can become a scientific laboratory or an industrial installation. Extraatmospheric observatory, biological greenhouse, a smelting shop producing metal alloys or semiconductor crystals impossible to obtain on Earth--this is only a short list of the programs for whose structural embodiment the "Cosmos-1443"-type vehicle-satellite may serve.

And now let us daydream a little. Imagine several large units for a future space settlement placed in near-earth orbit. Each of them in turn is mated to a space tug which takes them into their working orbit and fits them together like cubes, building a huge structure. The development of space technology makes it possible to talk realistically about assembling orbital stations, in principle of any mass, volume and size, in near-earth space from independent units (sections, elements or space vehicles).

9642
CSO: 1866/158

AVDUYEVSKIY ON 'COSMOS-1443' ROLE AS TRANSPORT SHIP AND SPACE TUG

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 3 Jul 83 p 4

[Article by academician V. Avduyevskiy: "Space Truck"]

[Text] In accordance with the space research program, on 28 June 1983, the "Soyuz T-9"--"Salyut-7"--"Cosmos-1443" new scientific research complex started its work in manned mode in near-earth orbit. It weighs 47 tons and is almost 35 meters long. The new "Cosmos-1443" freighter is operating as part of this complex. This is what academician V. Avduyevskiy told our correspondent.

The experience of Soviet cosmonautics has graphically shown that by docking individual space vehicles in orbit it is possible to create complexes of virtually any complexity. However, in order for such complexes to function for long enough periods, send up replacement crews, and expand and deepen the program of research and experiments conducted aboard them it is necessary to solve the problem of delivering substantial reserves of fuel, products and substances that provide life support for the crews into orbit, along with large elements of complex space structures and other freight. At the same time it becomes necessary periodically to return to Earth the samples of various materials obtained in space experiments.

Until now the problem of deliveries to orbit has been partially solved using the "Progress"-type freighters. In the future, too, they will play an important role in providing support for the prolonged functioning and enhanced efficiency of orbital complexes. But new tasks require the use of equipment that offers more facilities. In response to this requirement a new transport vehicle was developed, one of whose versions is the "Cosmos-1443."

It should be emphasized from the outset that already today this heavy space apparatus can be used not only as a transport but also as a space tug. It is capable of transferring heavy space objects, even as large the "Salyut," from one orbit to another with the necessary accuracy. On the other hand, depending on the program, the vehicle can be equipped with a reentry vehicle.

"Cosmos-1443's" main parameters give an idea of its operational facilities. The total weight of the vehicle with payload exceeds 20 tons in orbit. It

is more than 13 meters long, with the diameter of the wide section topping 4 meters. A "Proton" carrier rocket is used to launch the vehicle. In the version that the cosmonauts are now working with the vehicle consists of an orbital assembly and is equipped with a reentry apparatus. The volume of the sealed hull in the orbital section is 50 cubic meters. It contains the onboard systems that insure both automatic flight and flight as part of a complex. On the other hand, the space in the new vehicle can be used as living accommodation for the space complex.

After docking with a station, "Cosmos-1443"-type vehicles do not become its "dependent." On the contrary, if required they can transfer some of their electric power to the station. For this, the power supply system includes adjustable solar batteries whose span reaches 16 meters with a total area of 40 square meters. In addition, they can transfer some of their fuel to the station. The ship's reentry vehicle is equipped with a braking engine and systems capable of insuring automatic flight after separation from the orbital section, a controlled descent and soft landing using a parachute system. Using this reentry vehicle up to 500 kilograms of freight can be returned to Earth.

The development of the "Cosmos-1443" was preceded by a great deal of work during the course of which all the vehicle's design elements and systems were carefully worked out, along with methods and means for carrying out the necessary maneuvers. The prototype of the vehicle was the "Cosmos-929" artifical Earth satellite, launched into orbit in 1977; after completing a flight of 201 days, on a command from Earth it ceased to exist. The next step along this road was the launch of the "Cosmos-1267" satellite. As is known, on 19 June 1981 it docked with the "Salyut-6" station, forming a scientific research complex in near-earth orbit weighing about 40 tons. From that moment the "Cosmos-1267" insured the movement of the orbital complex and its orientation and stabilization. Several dozen maneuvers were carried out with its engine installation and the orbit of the complex was raised.

In other words, even then the new vehicle was being tested as a space tug. At the same time it insured automatic operation of the "BST-IM" submillimeter telescope mounted aboard the "Salyut-6," which requires high accuracy when being guided onto objects being studied.

When the "Cosmos-929" and "Cosmos-1267" were being tested, their reentry vehicles landed in the planned region with a high degree of accuracy.

On 29 July 1982, following completion of all planned experiments, using the propulsion system of the "Cosmos-1267" the orbital complex was returned from orbit and landed in the planned region. The results of the joint flight with the station made it possible to conclude that this kind of automatic vehicle-satellite makes it possible to considerably increase the active existence and efficiency of future orbital complexes.

As is known, the present "Cosmos-1443" was launched on 2 March this year. During 8 days of autonomous flight, checks were done on the main systems on the vehicle and orbit corrections were made, after which, on 10 March it docked with the "Salyut-7" station on the side of the transfer section.

After this the "Cosmos-1443" assumed control of movement of the complex in autonomous flight. In particular, using its propulsion system the orbit was corrected in such a way that the "Soyuz T-9" and its crew could be received.

The program for the joint flight of the "Soyuz T-9"--"Salyut-7"--"Cosmos-1443" complex provides for an entire series of scientific studies and experiments, during the course of which the onboard systems of the "Cosmos-1443" will insure the necessary orientation and stabilization. At the same time further tests of the onboard systems, units and structures and design elements will be conducted and methods worked out for controlling orbital complexes of great dimensions and weights.

The "Cosmos-1443" took about three tons of freight into orbit. It included fuel, food containers, and water and air containers, replacement spares for units and assemblies in the station's service systems, movie and photographic material and much else. Most of this freight was loaded along the sides of the vehicle's freight compartment.

To make it convenient for the cosmonauts to work with the freight loaded in the containers (and moving them even in weightless conditions presents many complications) provision was made in the compartment for trolleys that move on guides.

In principle the very first results from the testing of the "Cosmos-1443" make it possible to draw a number of conclusions. In particular, looking ahead, we can talk about the assembly of individual units--sections, elements or modules of orbital complexes of any weight or dimension. In these cases, instead of a freight reentry apparatus, vehicles of the "Cosmos-1443" type can carry modules--extraatmospheric observatories, biological greenhouses, smelting shops producing metals or semiconductor crystals with properties unobtainable on Earth--and at the same time play the role of space tug, assembling complex space structures from individual elements.

9642
CSO: 1866/159

LEONOV RECALLS FIRST EVA

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 18 Mar 83 p 4

[Article by Maj Gen Avn Aleksey Leonov, USSR pilot-cosmonaut, twice Hero of the Soviet Union: "The Friendly Solar Wind"]

> [Text] For the first time in the history of Earthlings, on 18 March 1965 one of them opened the door of his home--not a terrestrial one, but one in space--and stepped out over its threshold. He was face to face with the Universe, with an abyss of stars and worlds. What did he go through in those 12 minutes? What does he feel today when he guides the studies of new crews for whom a walk in space has become a standard operation? How does he envision future assemblers in space? At the request of our readers, Maj Gen Avn Aleksey Leonov, USSR pilot-cosmonaut and two-time Hero of the Soviet Union tells us about this.

I should probably begin with that morning when Sergey Pavlovich Korolev took us to the shop where the "Voskhod" spacecraft were being assembled. "Voskhod-2" already differed noticeably from its elder brother. The orientation engines were placed differently. There was a strange "corridor" near the access hatch.

When the curiosity of us young cosmonauts was fully aroused, Sergey Pavlovich said that this is a "window into open space." He always knew how to speak not only precisely, but also figuratively. We remembered his saying that a sailor at sea can and must know how to swim if he gets off his ship. A cosmonaut also has a ship, and an ocean, which means that he needs to learn about it.

At that time all of this seemed fantastic. But then Korolev finished his excursion into the future: "So I will ask you to put on a spacesuit and see how it is to work in it. At 1200 hours, at the meeting of the chiefs, you can give your opinion."

I even flushed from the unexpedtedness of this. To give my own opinion! I thought this was a random choice in this case. However, Yuriy Gagarin winked boldly. Here, they say, there are no accidents. "Congratulations--you were chosen!"

Thus, the road from fantasy to reality began. Properly speaking, it began much earlier, in the designers' discussions, or when the testers fitted me for this spacesuit and tested the heating and cooling units in it.

In 1964, the magazine SATURDAY EVENING POST wrote: "When the first man goes out from his ship into space, we will become witnesses of a most exciting event...And if this man is not an American, it will be distressing to all of us. However, if they suggest to us that he must be an American, then we are completely confident that he will be an American and if, instead of this, he turns out to be a Russian, it is simply dreadful to think how we will all be demoralized..."

I do not think that we were threatened with "dreadful demoralization" if it had turned out that we were not the first in open space. We solved our problems quietly and thoughtfully, without ballyhoo and sensations, without making them dependent on any degree of haste.

In any case, now they were casting the body supports. This was then being done for the first time: a naked man is placed in a trough with liquid plaster of Paris and he lies there until that "sour cream" hardens. Once they slipped and put it in so that I could not get out. My comrades had to pull me out, along with pieces of plaster of Paris that had stuck to me.

And then there was--no jokes here--the ascent in the thermal vacuum chamber. First in the spacesuit, and then also with the ship. At an "altitude" of 60 km, we did everything by the book, leaving and ship and then going back into it. That altitude, 60 km, is sufficient to convince one of the reliability of his armor. Only then one's shoulders hurt: all the same, one feels the full force of Earth's gravity.

Finally, 18 March arrives. All the instructions have been given, all the actions stipulated. In general, however, no one can say exactly what awaits man outside the walls of the ship. No one, except...Tsiolkovskiy. Both before the flight and after it, while rereading "Off the Earth" I was astonished at what accurate instructions that great scientist from Kaluga had left us about the excursion into open space.

Sergey Pavlovich, who was standing at the foot of the rocket just before the launch, said: "Be very careful not to complicate matters up there. Just go out and come back in." He was silent for a moment and then added: "May the solar wind be your fair companion."

My commander, Pavel Belyayev, went through just as much. Of course, it would have been easier for him to "dive" overboard than just give the commands.

Everything took place so quickly you would not believe it, given today's canons of cosmonautics. Right at the end of the first orbit, when we were over Kamchatka, we opened the airlock. I stepped into it.

And then I was sticking out of our space "refuge" up to my waist. First impression? The Sun. According to the instructions, my light filter should have been closed completely. However, curiosity won out: I covered only half my face. And then it was if an electric welding arc struck it. The disk was flat, without rays or a corona, but impossibly dazzling. Even with a gilded light filter that was 96-percent opaque, the brightness was like that at Yalta at noon on a summer day.

At the same time, the sky was very black and starry. Stars above and stars below. A sunny night! Or a starry day?

It went very simply. I stepped to the edge of the hatch and...it took my breath away. All of the Black Sea was completely visible. The Caucasus was beneath me! To the left were the Balkans and Italy and to the right, on the horizon, was the Baltic Sea. No man had ever seen such beauty before!

Beauty is beauty, but I had work to do. I removed the cover from the motion picture camera that I had picked up. I pushed off from the threshold and swam out to the end of my tether. Now, because of safety reasons, cosmonauts are categorically forbidden to do this and must keep hold of a life line. I then immediately decided to try everything. I swim and I hear in my headphones Pavel's solemn voice: "I am 'Diamond'! Man has gone out into open space! He is swimming freely!" I do not understand it at all at first: who went out there?

Before the flight I had to hear all about the dangers that might overcome man's psyche as he contemplates the abyss that has unfolded before him. Now all of this has floated away into theoretical nonexistence, and the reality fills my consciousness entirely. I see Tsemeskaya Bay and the outlines of the Crimea. I see how spring is moving from south to north--the white is yielding to black and green. The clouds over the Volga repeat its relief precisely: here, also, the Zhiguli has its own cloud "bed." Over the Urals I turned somersaults on my twisted tether: first to one side, then to the other...

Four times, in all, I left and ship and returned to it. The ship surprised me no less than the Earth and the stars. Silvery, majestic, with antenna "feelers," patches of light--a true stellar frigate. Even the reference points on the hull were visible. I checked the ship for stability; as it turned out, blows can make it rock.

I still remember the beating of my heart and the sound of my breathing in that absolute silence. As if from the side. As it turned out, this is the breathing of the Universe. Not long ago, in the film "2001: A Space Odyssey," by Arthur Clarke, the flight of the ship was accompanied by these same "native" sounds.

What did I not do? I did not photograph the ship, as was intended. The camera hung on my chest, but the manipulator was on my right side, near my thigh. On Earth and in airborne weightlessness I could reach it, but up there I stretched and stretched, and kept missing it by some 2 millimeters. It must have been the difference in the outside pressure.

The re-entry did not go as planned, either. What I had practiced many times on Earth went differently in space: I could not enter the airlock immediately, feet first. After the free flight, it was as if the spacesuit was sort of "wrong." While in motion, I changed my technique. I went head first into the airlock, turned around there, and then went feet first into the ship, directly onto my couch. We were over the Yenisey River at the time.

From Earth, Sergey Pavlovich asked: "What did I tell you before the launch?" I answered: "Go out and turn around..." "And what else?" "That's everything, I think." "You ought to remember a little better." And I remembered: "The fair solar wind." Korolev began to laugh: now I had it right.

I understood that this was how he was checking the state of his space "pedestrian's" introspection after all the impressions that had just been experienced. I still

save his photograph, which he inscribed: :Let the friendly solar wind accompany you all your life."

And now, around me there is a whole detachment of cosmonauts who have gone outside their ship. At times they are given difficult assignments. I am proud of how bravely and skillfully Vladimir Lyakhov and Valeriy Ryumin freed the radio antennas of the "Salyut-6" station from that insidious steel network, thereby prolonging its life for two more extended expeditions. I am envious: I would like to have been there when Anatoliy Berezovoy and Valentin Lebedev flew around our planet on the step of their "wagon" for the last time. What are my 12 minutes when compared to their 2-1/2 hours? I am happy about the newness of their space armor. I recall how water gurgled in my spacesuit: it was full of sweat up to my knees. After I went out, my body temperature rose 1.8 degrees in 20 minutes, to the verge of heat stroke. In a day I lost 6 kilograms. Again: for breathing and ventilation I had a total of 60 liters of compressed air. Today the creators of spacesuits, along with water cooling (through a radiator sleeve) have "assigned" 360 liters of oxygen per person.

And, of course, I dream. I am certain that hundreds of boys born in the year of the first sortie "overboard" from a home in space will work in orbit as engineers, researchers, welders and assemblers. We will see multiunit orbital structures put together by their hands: shops, houses, settlements. We will receive the industrial output of orbital plants for the good of science, progress and the people's welfare.

As you can imagine, thanks to all this it was fiendishly pleasant to be able to say to the Earthlings that day: "It is possible to work in space."

11746
CSO: 1866/132

SPACE SCIENCES

TELESCOPE WITH 25-METER SEGMENTED MIRROR PLANNED

Moscow IZVESTIYA in Russian 28 Apr 83 p 5

[Article by B. Konovalov, science reviewer, IZVESTIYA: "In the Future--a Giant Telescope"]

> [Text] Since 7 January 1610, when Galileo first looked at the night sky through a telescope, progress in astronomy has been inextricably linked with improvements in that instrument. Right now the largest telescope on our planet is a Soviet one. It was built in the North Caucasus, near the village of Zelenchukskaya, and has a main mirror that is 6 m in diameter. The second largest telescope, with a mirror 5 m in diameter, is located on Mount Palomar in the United States. "It is possible that they will remain the largest of all the telescopes built on Earth," wrote the well-known American science popularizer B. Bova in his book "The New Astronomy."

Actually, the mirror of our largest telescope weighs 42 tons without its mounting, and 90 with it! Transporting it into the Caucasus just once was an extremely complicated problem. If the mirror diameter were to be increased even further, the complexity of the creation of the telescope and its cost would truly increase in a geometric progression. Therefore, specialists think that in the foreseeable future telescopes with mirror diameters exceeding 10 m will probably not be built. At the same time there is a whole series of problems that require the use of mirrors with much larger dimensions.

Scientists at the USSR Academy of Sciences' Crimean Astrophysical Observatory are working on the solution of this problem in a roundabout way: not a solid, large mirror, but a component one. Right now they are discussing a variant of an optical telescope with a mirror 25 m in diameter! Like a "mosaic panel," it requires the assembly of about 500 sitall hexahedrons that have an area of 1-1.2 m^2 each. The thickness of each of these hexahedrons will be much less than would be required for a solid mirror. The calculations of the Crimean scientists show that all the optics for a 25-m telescope (including the main and secondary mirrors) should weigh 150 tons. Let us remember that the 6-m telescope's mirror weighs 42 tons. However, the collecting surface of a 25-m telescope is larger by a factor of 17!

Complication of the control of the telescope is the price paid for this gain. Each hexahedral cell must have a control system that will enable it to carry out its assignments in the overall "ensemble" of the mirror most efficiently.

Of course, a 25-m telescope must have extremely imposing dimensions. The length of its tube would be about 70 m. If the metal parts were made of steel, the weight of the tube and its revolving bracket would be about 4,000-5,000 tons. Controlling such a bulky, cumbersome object and insuring smoothness of movement and sufficient structural rigidity would be an extremely complicated problem. In order to understand the problems facing its builders, it is probably sufficient to say that the revolving part of the largest telescope at the Crimean Astrophysical Observatory, which has a mirror 2.5 m in diameter and was the largest one in Europe for a long time, weighs a total of 60 tons.

In the development of the giant telescope, much that is profitable came from the experience gained in building the Zelenchukskaya telescope, for which progressive structural solutions were found, particularly for the so-called alt-azimuth setup. In this layout, which was first used by Soviet designers, the telescope's main axis does not point at the pole star, as is the case for almost all existing telescopes, but is aimed at the center of our planet. Although this makes it more complicated to control the telescope when tracking a star, it reduces the gravitational loads substantially. For giant telescopes, this is a matter of primary importance.

Galileo's telescope--the first one in history--gathered 144 times as much light as that natural "optical instrument," the human eye. The Zelenchukskaya telescope gathers at least one million times more. A 25-m giant would increase by a factor of 17 this most important characteristic of telescope sensitivity. Objects in the Universe with a luminosity level only one percent greater than the night sky background could be investigated.

"This is of extreme importance for astronomers," say Nikolay Vladimirovich Steshenko, doctor of physical and mathematical sciences, deputy director of the Crimean Astrophysical Observatory and leader of the project. "A new generation of giant telescopes will push back even further the boundaries of the observable part of the Universe, will make it possible to penetrate deeper into its past and, on the other hand, will make it possible to investigate rapid, unstable processes arising in the stellar worlds, follow the birth of stars and solve many other very important problems. The study of our own stellar home, the Solar System, will also rise to a new level. Planetary spectra obtained with the help of a 25-m telescope, with spectral resolution that is still impossible to achieve in practical astronomical observations, will make it possible to investigate in detail not only the physicochemical composition of the atmospheres of our Earth's heavenly "neighbors," but will also yield complete data on the movements of matter in their atmospheres and make it possible to determine the nature of the asteroids and study their structure in detail. With the appearance of telescopes of a new generation, mankind will have the real possibility of detecting planetary systems around the nearest stars and find out whether or not the existence of some life forms similar to ours is possible."

However, while astronomers are working on plans for giant telescopes, our terrestrial life can make unexpected alterations in them. Many observatories on Earth are no longer meaningful because cities, with their smoke and the shine of their electrical fires have come too close to them. For unique gigantic telescopes, unique conditions will be needed. In our country there is a whole series of excellent locations in Kazakhstan and Central Asia that have pure mountain air and are far from cities and large settlements. However, it is already time to think about making these areas into reservations and forbidding any industrial construction in them. Yes,

there is another side to the medal of civilization. And now we must think about the creation of astronomical reservations. Mankind will need them no less than the normal nature-guarding reservations.

11746
CSO: 1866/135

HISTORY OF KAPUSTIN YAR COSMODROME

Moscow PRAVDA in Russian 6 Jun 83 p 3

[Article by V. Gubarev, special correspondent: "Kapustin Yar: A Look Through the Years"]

[Excerpt] I love this city. Its people, its past and present, its heroic feat. No, it was not from Kapustin Yar Cosmodrome's launch pads that the first artificial Earth satellite and the legendary "Vostok" started their flights. The great honor of opening the space era for mankind fell to Baykonur's lot. However, our well-known Kapustin Yar Cosmodrome was always the elder brother, because the road to space began right here, on the local steppes.

The first Soviet rockets appeared in the 1930's, and in those years the famous designers--including S.P. Korolev--began their work. After the victory they met again. Many of those who came here for the first time immediately after the war are no longer with us, but Kapustin Yar preserves their memory, not only with obelisks and street names, but also--and chiefly--with their deeds. In the evening, if one looks to the east, from time to time it is possible to see a bright little star that does not set but flies swiftly upward. This is Kapustin Yar "at work": the next artificial Earth satellite is leaving its launch pads. And each launch is a tribute to the memory of such people as S.P. Korolev, M.K. Yangel', N.A. Pilyugin and many others of our famous countrymen for whom Kapustin Yar became the beginning of their great achievements.

The city's biography resembles that of a human being. It contains childhood, and youth, and maturity. By right, Kapustin Yar's history begins in October 1947. On the 18th, our country's first ballistic rocket was launched. Those who saw it off on its flight included people whose names would make Soviet science famous in just a few years.

The memory of those years is carefully preserved. One day some veterans met in the Palace of Culture. They reminisced about days past.

"Each of us made it through the war," said one of them, "and then the Party sent us here. Believe you me, we worked like it was wartime. The conditions were unbelievably difficult: the bare steppe, no water, a difficult situation with food--there was a severe drought in '46. True, the local amateur fishermen came to our rescue: there's always the river, and the lakes near it. However, we worked 18 hours a day and understood how necessary it was to launch the first rocket. Sergey Pavlovich

was right alongside us, and from morning to evening he vanished into the erecting shops, which is what we called that house that was thrown together from boards where they were assembling the rocket. That's where the designers' drawing tables were."

"There were no roads," recalls another veteran. "Then a macadam road appeared, and it even had bus stops along it. Later, early one morning we went out to the railroad and walked along the ties. By the way, the first time I went into the erecting shops, I was accompanied by a man in a leather jacket. It was Sergey Pavlovich Korolev. His coat was very well known--many people did not know him by his first name and patronymic, but said: 'Go see the leather jacket and he'll explain everything.' And, actually, no matter what question someone approached Korolev with, he explained in detail, without hurrying. He always found time for that. Sometimes we called him 'The Academician.' Jokingly, of course. We didn't think that there would come a time when Sergey Pavlovich would become the legendary Korolev...and an academician!"

"The rocket was on the launching pad. It was beautiful," recalls one of the pioneers. "We were all young, almost boys, and the designers weren't much older--Korolev was already 40, but he didn't think he belonged with the 'old men.' I remember how gloomy the situation was with the oxidizer: there wasn't much of it in the postwar years, but we were using it up rapidly...We fueled the rocket, said goodbye to it, and went into the shelter. And suddenly there was a wave of fire, like an explosion above the steppe, and the rocket shuddered and started to rise slowly. We were watching it like people in a spell. Some shouted: 'It flies! It flies!' And the rocket, as if it had changed its mind, gathered speed and quickly disappeared from sight...What was begun here! Everyone was hugging and kissing each other--members of parliament (five deputies of the USSR Supreme Soviet were there at the launch) hugged workers, chief designers hugged testers...universal rejoicing! The first design offices and other organizations that undertook to create ballistic rockets were formed as long ago as 1946. I remember that Korolev said: 'Such things we are beginning...you cannot even imagine what things we are beginning!' And he smiled tiredly: it was incredibly difficult for him, because on his shoulders lay not only the 'rocket troubles,' but also other matters having to do with the installation and the lives of his people. By the way, a 'green revolution' soon started in Kapustin Yar..."

In the center of the city there is a park. The inhabitants love to rest there when the working day is over. It is cool in the shade of the trees and even difficult to believe that nothing grew on the steppe: even the grass burned up in the heat and dust ruled everywhere. One day an irrigation specialist arrived from Central Asia. The wives of the workers gathered together and the guest told them in detail what they had to do in order to have lanes and parks in the lifeless steppe. And then each family was allotted trees. They nursed them as if they were children. And in a few years Kapustin Yar became one of the greenest cities in the area.

Later, when Baykonur's biography was beginning, Kapustin Yar's experience was used there, including the planting of greenery. However, it was still a long way to Baykonur, because the main events were still taking place in Kapustin Yar.

"We greeted the October holiday in a good mood," recalled Academician N. Pilyugin, "since we had launched several rockets. There were unsuccessful ones among them, of course, but the birth of our branch of science and

technology was a difficult one. I believe 13 rockets were launched in October and November. Here we were, gathered together on the occasion of the holiday, and Sergey Pavlovich immediately set up a 'production conference'--he was unable not to think of business. We had grounds for being happy: we had carried out the assignment given us by the Party and the government--there was a rocket--but Korolev was looking far into the future. And instead of a holiday toast, he said: 'There are no prospects for the rocket design we have, so we have to develop a new one!' We argued with him, of course, but each of us understood that Sergey Pavlovich was right. We decided to do it this way: one type of rocket is being tested, another is being built, and a third is being developed. Rocket launches soon became a customary thing in Kapustin Yar."

The youth of Kapustin Yar...those years when science approached space in earnest. Geophysical rockets rose upward, reaching the same altitudes that would soon be occupied by the orbits of artificial Earth satellites.

Academician A. Blagonravov was the chairman of the State Commission for the launching of the first "academic" rockets...

"It sometimes seemed to me that on the eve of a launch I would have a heart attack," recalled Anatoliy Arkad'yevich in Vienna while greeting the delegation of Soviet scientists to the First United Nations Conference on the Peaceful Use of Space. "You can imagine how the possibility of sending equipment beyond the limits of the atmosphere appeared to scientists! However, the size of the scientific compartments was limited, and that is where the 'fight' for places and weight began.... We were young and hotblooded! At the commission meetings it sometimes got so bad that I had to use my power. Well, they considered me to be the chief reactionary, of course: why, they said, did they give preference to the biologists, and not the physicists!" Blagonravov spread his hands helplessly. "But we tried to satisfy everyone as far as we were able. The "sufferers' this time were given preference during the next launch.... The times were hard, but one remembers them with pleasure. Parents always remember the first steps of their baby, just as we will never forget those years at Kapustin Yar, from which we have come so far," the academician pointed upward, to the evening sky where stars were already twinkling.

Four-legged passengers soon appeared in the rockets. The more one learns about the history of Soviet cosmonautics, the more one is amazed: so much wisdom, insight and bravery those pioneers had! Rocket technology had essentially only just begun, but the enthusiasts were thinking about the time when rockets would subjugate space and time. No, they not only dreamed of the future--they drew nearer to it! More than 10 years before Yuriy Gagarin went up, if one talked then of manned flights into space, he would be called eccentric and a fantasizer. Nevertheless, as early as the end of the 1940's Kapustin Yar began preparing for 12 April 1961.

"In the nose cone of the rocket we set aside a small space into which we placed two dogs," relates Doctor of Medical Sciences V. Yazlovskiy, "Besides that, in this compartment we placed instruments that provided the conditions for life: a regenerating unit, instruments for recording the physiological functions of the animals during the flight. From the middle of the year until September we launched six pairs of dogs; some of them even flew twice. We gathered the world's first experimental data on the reactions of a living organism to rocket flights. The greatest

difficulties arose in connection with returning the dogs to Earth. Ejection trolleys appeared: one of them separated at an altitude of 86-90 km, the other at 45 km above the Earth. Then the animals descended by parachute for about 60 minutes. Nine experiments were conducted with pressure suits. Al'bina and Kozyavka--the most experienced 'stratonauts'--flew twice. They dealt so well with the pressure suit that they were reluctant to leave it when they returned to Earth. We tried to lure them out and pet them, but they just backed away and climbed into the pressure suit again. We conducted quite a few experiments at Kapustin Yar and accumulated a huge amount of material that was later used to lay the foundation for the possibility of a manned flight into space. We began preparing to launch Layka..."

The famous Layka went up from Baykonur Cosmodrome. Kapustin Yar passed the baton on to its brother. Many of those who started in the steppes along the Volga moved to the steppes in Kazakhstan. New launch vehicles, capable of lifting artificial Earth satellites and spacecraft, appeared. Baykonur was more suitable for them. At the beginning of the 1960's yet another cosmodrome appeared, at Plesetsk, and it seemed that Kapustin Yar's "space" history would end on this note.

However, in the fall of 1969 Kapustin Yar was faced with turning yet another glorious page in the history of cosmonautics.

In October--22 years after the launch of the first ballistic rocket--guests from the fraternal socialist countries gathered here. They included presidents of academies of sciences, scientists and specialists from the countries participating in the "Intercosmos" program, although the first satellite contained equipment created in the USSR, the GDR and Czechoslovakia.

Many of the guests saw the launching of a space rocket for the first time, so their excitement and delight were fully explainable.

"This is an historic day that the peoples of our countries will always remember," said Bulgarian Academician L. Krystanov. "I wish to emphasize that this great feat would not have been possible without the scientists of the Soviet Union, its mighty science and technology, and its outstanding specialists, who are preparing to launch rockets and satellites. I am convinced that the collaboration of the socialist countries in the peaceful conquest of space will now be developed at a rapid rate."

"I see the sense of joint work for the enrichment of science, particularly in those areas with which we were previously not concerned," noted Ya. Kozheshnik, president of the Czechoslovakian Academy of Sciences. "Extraterrestrial investigations are truly of practical importance. Kapustin Yar Cosmodrome also opened the way for Czechoslovakian science to enter space..."

"I believe that it will not be very long," Academician B. Petrov then said, "until space centers will appear in all the socialist countries and will be used to create equipment for the investigation of space. And our country will place modern rocket technology at the disposal of our colleagues."

It must be confessed that, as it turned out, Boris Nikolayevich exaggerated somewhat when he asked if it was really possible to develop the "space industry" quite rapidly. However, subsequent events demonstrated just how right the prediction of this well-known Soviet scientist was.

"Intercosmos-1" began on 14 October 1969. The flags of the countries of the socialist concord were flying on the launching pad. Four times in the course of the year Kapustin Yar saluted the "Intercosmos" program with rocket launches, opening a new stage for it: the scientists and specialists of the CEMA member countries could now work directly in space.

Two more cosmodromes--at Plesetsk and Baykonur--soon joined Kapustin Yar. First they launched satellites, then the series of international expeditions on the "Salyut" orbital stations.

I love to go to Kapustin Yar, and not only because I have many friends at the cosmodrome--launches of satellites in the "Cosmos" and "Intercosmos" series and "Vertikal'" geophysical rockets now take place regularly--but because of the memories, of which there are many in Kapustin Yar. On the very place where the first ballistic rocket was launched in October 1947, a rocket made of concrete was later raised above the steppe. The road to the launching pads runs past this monument...

11746
CSO: 1866/147

NOTES ON HISTORY OF PLESETSK COSMODROME

Moscow PRAVDA in Russian 20 Jun 83 p 3

[Article by V. Gubarev, special correspondent: "Plesetsk--the Launching Point"]

[Text] Plesetsk Cosmodrome is making a substantial contribution to the legend of "flying saucers" (NLO's).

A call from Sheremet'yevo. An agitated voice: "I'm the second pilot of an IL-62. Yesterday evening during our landing approach we observed something unusual. A fiery point rose above the horizon, flew parallel to our course for some time, then abruptly took off upward!"

Another call, from Shatura: "We'd like to find out what we saw yesterday while we were fishing. About midnight I got out of bed and glanced to the east. Something unusual was moving through the sky: a flame was coming out of a shining point. Was it a 'flying saucer'?"

Upon being told that he had seen the launching of an artificial Earth satellite from Plesetsk Cosmodrome, the fisherman did not believe it...actually, on clear days when an anticyclone has set in, even from the Moscow suburbs it is possible to see the working third stage of a launch vehicle lifting a satellite into orbit. In many other cities that are located "around" the cosmodrome, they are seen much more frequently.

We are accustomed to Baykonur and Kapustin Yar, to their wide-open steppes, where the launching area is visible from far away. But Plesetsk is unusual, and every encounter with it is remembered. I went to its launching area for the first time in winter, when preparations were being made to launch an "Intercosmos" satellite.

The road ran through a forest. It was getting dark rapidly, and the light from the headlights was snatching from the darkness the trunks of fir trees that were interweaving their branchy paws. There was a lot of snow that year, and it lay on the branches, causing me to feel that the fir trees were giants carrying whimsical white scarves.

The freeze was a pretty good one--more than 30 degrees. A breeze sometimes blew, flicking the snow away from the firs, and it whirled over the launching area for a long time, turning silver in the beams of the searchlights that were illuminating the rocket.

The observation point was on the edge of the forest, right next to the pad where the rocket stood, ready to be launched.

"Now I understand the meaning of the Russian expression 'fairytale beauty'," noted Tanya Ivanova.

We called this young Bulgarian lady "Miss Intercosmos," because she was the first woman from the fraternal socialist countries to be invited to the cosmodrome. Tanya was preparing to launch equipment built in Bulgaria that was now to be sent into space for the first time. In just a few years, instruments developed by Bulgarian and Soviet specialists would be carried by many satellites and even the "Salyut" orbital stations, but then, in "Intercosmos-8," the first of them were being launched: Bulgarian scientists and specialists had accompanied them on their flight to the cosmodrome.

Tanya was right. Actually, no matter how often one watched the launching of rockets, this one was special. A night launch is always striking because of the wealth of colors, even more when the launching pad is so close to the observation point.

"Launch!" we heard from the loudspeaker.

And immediately a bright, fiery ball that had appeared at the base of the rocket illuminated the forest around us. Waves of light were reflected repeatedly, little sparks of snow flashed, and an artificial sun was born in this snow-white bowl. It tore itself from the Earth and started climbing above us slowly, turning night into day.

The rocket rose, saluting us with multicolored rings that appeared around it (I later learned that they were optical effects).

Later I had many opportunities to talk with Bulgarian specialists who had many space launches to their credit, but every time they said that that one, their first launch, was unforgettable and astonishingly beautiful.

However, Plesetsk is unique in its launches! In summer it is different: one sees the green richness of the taiga and the blackish blue surfaces of the lakes. There is also the smell of mushrooms, of which there are vast quantities.

Taiga, lakes, roads, comfortable houses and, finally, the launching complexes--such is Plesetsk. One thinks involuntarily: just how did all of this appear here? And before us opens another page in the space annals of our Motherland and the great feat of the people who created this cosmodrome.

The biography of Plesetsk, as with Kapustin Yar and Baykonur, begins with the builders. The architects of Baykonur are rightfully proud that in the most savage heat and the heaviest freezes they did not slow down the construction of the launching complex from which the first artificial Earth satellites and Yuriy Gagarin started on their ways. "Honorable Builder of Baykonur"--the pioneers wear this badge on their chest with honor.

Unfortunately, there is still no analogous badge for the builders of Plesetsk, although their professional and human endeavors are akin to those of their colleagues.

A cosmodrome is a very complex engineering structure. It is necessary to have a measuring point, where trajectory measurements can be made during the flights of rockets and satellites and information can be transmitted to and received from objects in space. At a cosmodrome there are a lot of structures of all possible types, and it is necessary to construct heat and electric power stations, power plants, approach roads and transportation lines. And, of course, it is necessary to have a well-organized settlement where the cosmodrome's workers can live.

As far as the amount of construction work is concerned, a cosmodrome is equal to a hydroelectric power station, for example. However, its installations are scattered over a considerable area and are sometimes tens of kilometers apart.

At the location of the future cosmodrome the builders found taiga that had rarely felt the foot of man. The most difficult thing that faced them, however, was the swamp. It was distended with gigantic bubbles: gas was escaping. It was necessary to find islets of firmness in the ground, which was oversaturated with moisture. When this did not work out, it was necessary to create artificial ground.

"A section chosen for construction frequently had to be changed," recalls one of the veterans of Plesetsk. "For example, the planners show us the construction site and tell us that according to the data in the geological survey, there's no ground water. Water immediately appears in the foundation pit. We bring in pumps, but the the water table doesn't budge. The planners begin to work on a new version, but the dates were set firmly and we knew very well that no one was going to change them for us: the launching complex must be ready precisely on schedule. Dmitriy Fedorovich Ustinov frequently flew out to see us on Saturdays. He was then secretary of the CPSU Central Committee. We told him about the new working plan. He approved it, then added: 'But the dates remain the same. You are builders, so a special demand is being made of you...I am quite confident you'll be able to do it!' And we builders didn't let him down, although we had to fight ground water and boulders. Well, I don't need to talk about the conditions--they were unbelievably complicated! However, the launching complexes were ready on schedule, and then there appeared a comfortable little settlement..."

Plesetsk Cosmodrome went into operation in 1960.

The new cosmodrome had the task of making its contribution to the use of Earth satellites to solve national economic problems, with special emphasis on communication and meteorological needs. Communications satellites insure the reception of television transmissions in remote regions of the country, as well as telephone and telegraph communicatios between Moscow and regions in Eastern Siberia and the Far East. The "Meteor" meteorological satellites observe the weather over our country and the world ocean. Their data are needed for the preparation of short- and long-term weather forecasts.

Satellites of the "Molniya" and "Meteor" series begin their journeys from the Plesetsk Cosmodrome more often than not.

The cosmodrome is also making its own substantial contribution to international cooperation. This does not mean just as part of the "Intercosmos" program, which brings together scientists and specialists from the CEMA member countries, but also France: the first "MAS" satellites were launched from Plesetsk.

Plesetsk has already been in operation for almost a quarter of a century. And there is one tradition that has been observed reverently there since the firstcomers appeared. This is a mass passion for...winter bathing. Yes, indeed. In Plesetsk, noted one of the veterans, there are more "walruses" than in the entire rest of the Soviet Union. They bathe during the most severe frosts.

I had to make sure of this at least once. As usual during the winter, the thermometer indicated less than 20 degrees. Glancing out of the window of the hotel early one morning, I saw people dressed in light exercise suits running toward the lake. Curiosity led me to its edge. Blocks of ice lay along the edges of an ice hole and in it, chatting merrily, swam both adults and young people. Among them were people I knew: the chief of the launching crew and testers.

Two hours later I again looked into the bright and spacious hall where the "Intercosmos" tests were being completed. It will fly above our planet for several years, and hundreds of scientists in different countries will make use of the new information that arrives from space. In a small village beyond Lake Baykal or near the Sea of Okhotsk the inhabitants will gather in front of television screens in order to see a direct transmission from Moscow. Weather forecasters will see the birth of a cyclone on photographs and warn that tomorrow the weather will change and rains will begin. Many threads tie the Earth and space together today, and we are alreacy accustomed to the fact that artificial Earth satellites are "standing" their daily watch in near-Earth orbits. Many of them began their ascent into space on the launch pads at Plesetsk.

11746
CSO: 1866/153

RESEARCH AREAS FOR 'ASTRON' OBSERVATORY SATELLITE

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Mar 83 p 3

[Article by V. Zubkov: "Stars, Give Us a Response!--New Astrophysical Observatory in Orbit"]

[Text] It is only on Sunday, on the 5th day after it was launched, that Astron will complete its first revolution. Thus, at times coming closer to earth, 200 km from it, and at times rising to 200,000 km, which is more than half the distance to the moon, it will describe ellipses for many weeks.

In appearance, the Astron resembles a snowman bundled up in a coat of vacuum-shielded insulation which protects the ingenious equipment against unbearable heat and cosmic cold. True, this "snowman" is over 6 m tall. Nothing superfluous is taken into space. For this reason, we can imagine how many "different things" it contains just from its size. In the first place, there is an ultraviolet telescope and x-ray spectrometer. Then there is a self-contained control system which makes it possible to aim the telescope on an object with great precision, as well as a radio system for precise measurement of orbital elements and communication equipment.

"This is the first time such a sophisticated apparatus as the Astron has been inserted in orbit. There are no analogues," explains one of the designers of the automatic station. Examination of the stellar sky in the optical range will hardly produce surprises. The 6-m telescope installed in the Zelenchuk Observatory has made possible a breakthrough in the range of visible radiation. And, although there are plans to develop larger optical telescope, questions are being voiced as to the expediency of implementing them.

New "windows" are needed for further investigation of the universe. Astronomers are achieving this in the radio, infrared, ultraviolet and x-ray ranges. The Astron is expressly a space observatory that is designed to function in the ultraviolet and x-ray spectra. The telescope mirror is 80 cm in diameter. It is modest in appearance, as compared to its "brothers" on the ground, but it is very big according to space criteria and makes it possible to look deeper than with the earth-based giants.

Development of a basically new space vehicle is a lengthy and complicated process. It requires many years of intensive work by scientists, designers and workers. Although there is already quite a bit of knowhow in developing automatic

and interplanetary stations and it was, of course, used, still, something new is something new. Particular difficulties were encountered in producing the telescope mirror. On the one hand, it had to have high qualities, should not bend and, heaven forbid, it should not crack at lift-off and, at the same time, it has to be lightweight. Finally the scientists succeeded in combining these contradictory specifications: the space mirror was one-third the thickness of its analogue on earth.

The x-ray telescope is smaller than the ultraviolet one. But it can be used to "examine" the tiniest objects that are invisible from earth, to search for and view very weak sources.

A. Boyarchuk, deputy director of the Crimean Astrophysical Observatory, corresponding member of the USSR Academy of Sciences, explained to us: "Use of an automatic station for astrophysical research has several advantages over using a manned orbital station for this purpose. The satellite can be inserted in a high-altitude orbit where the effect of earth and its radiation belt is insignificant and does not contribute appreciable distortions. Moreover, micro-accelerations from operation of life-support systems and other equipment on the station, which create noise for precision instruments, are ruled out. We hope to obtain new data with the help of Astron about neutron stars, 'black holes' and different galaxies with weak luminosity."

More discoveries have been made in the last decades than in the entire history of mankind. Such objects as quasars, pulsars, hot gas clouds and "black holes" have been discovered deep in space. Processes that take place with the birth and evolution of stars have become understandable. But one can see many fewer stellar objects than there actually are. The atmospheric shield does not let ther "voice" penetrate to earth's surface. For this reason, in their desire to break through it, astronomers have raised their equipment, which detects the slightests "rustles" of the universe, higher and higher.

As of now, the idea that the universe was born as a result of the Big Bang 10-20 billion years ago has become more or less confirmed. At that time, only light chemical elements appeared--hydrogen and helium. All the other elements, which subsequently formed the stars and planets, appeared, as it is believed, in the course of nuclear reactions deep in earth and from explosions of giant stars. But this is the most general conception. According to scientists, they expect that the equipment installed aboard the Astron will enable them to discern the fine points of this chemical synthesis.

So-called "supernovas" are the "furnace" in which new stars arise and appearance of supernovas is the most grandiose of the phenomena than can be directly viewed. The impact waves formed with such cataclysms are capable of initiating the formation of a myriad of suns, planets and moons. The opinion is held that the explosions of supernovas occur constantly in the gas and dust clouds where stars are born. The ultraviolet telescope will help take a look deep into these clouds.

Actually, even our galaxy is still a mystery in many respects to scientists. The solar system is situated on its "outskirts," 30,000 light years away from the center. The dense dust cloud, which attenuates lights by millions and millions

of times prevents us from looking into it with an optical telescope. But, on the other hand, this cloud is transparent to x- and ultraviolet rays, which can be recorded only from a satellite like Astron. Preliminary studies have made it possible to detect the center of our galaxy and expound the hypothesis that it contains a compact source of radio-frequency radiation, which is apparently connected to the tiny nucleus of the galaxy.

There are also plans to continue with studies of so-called dwarf galaxies, the mass of which is 10 to 100 times smaller than the mass of regular-shaped galaxies, with the help of Astron.

"For me, this is the 23d space experiment," states V. Kurt, doctor of physico-mathematical sciences. "I was fortunate enough to participate in work with the third artificial earth satellite. Later, I worked with various manned and automatic vehicles. But we are placing the highest hopes in Astron. I am waiting with particular impatience for the results obtained with the x-ray telescope. In particular, we expect that it will give us new data about the mysterious pulsars, which are 10-20 km in diameter."

As it orbits around earth, the orbital observator will "drop" information to ground-based measurement centers. But it is so complex that only an electronic computer can interpret it rapidly.

The Astron is a general-purpose tool that astronomers could not even dream of a short time ago. Scientists and specialists from the Crimean Astrophysics Laboratory, Institute of Space Research, Byurakan Observatory and Laboratory of Space Astornomy in Marseille participated in creating it. A special line of communication was organized for the duration of operation of the orbital telescope, over which the obtained data will be delivered to Toulouse.

The launching of Astron is a scheduled stage of Franco-Soviet collaboration in the area of space exploration.

10657
CSO: 1866/104

'ASTRON' STATION BEGINS RESEARCH PROGRAM

Moscow IZVESTIYA in Russian 9 Apr 83 p 2

[Article by B. Konovalov, IZVESTIYA special correspondent: "The Universe Wide Open. The Soviet 'Astron' Near-Earth Station Has Started Its Studies of the Star Worlds"]

[Text] The sound was loud and sharp, like a shot.

"Now the locks are open," said N.P. Nekhayev, a design engineer at the USSR Academy of Sciences Crimean Astrophysical Observatory, and he folded back the cover of the telescope. "You can take a look now."

A long black cylinder strung with the "ribs" of circular diaphragms lay open in front of me. From deep inside a large mirror reflected our faces, magnifying them in size. The black flare of a long blind, looking like an exotic flower, stretched upward from the center of the mirror. Deep inside it the upper receiving part of a spectrometer gleamed like an eye. This telescope was an accurate copy of the one that is now in space conducting studies aboard the Soviet "Astron" near-earth station.

Aboard the "Astron" the telescope cover was first opened on the fifth day after its injection into orbit. This was earlier than planned by the designers. Before the start of operations they wanted any volatile gases given off by any of the telescopes components to be sucked out, like a vacuum cleaner, through special technologic slits by the vacuum of space. And the diameter of the inlet slit on the spectrometer is only 40 microns. And any small dust particle landing there is much more dangerous than it would be if it got into your eye. The visual acuity of the telescope could be seriously affected for the worse and it would not justify the hopes of its designers.

While still on Earth colossal significance attached to cleanness. A special clean premises without windows was set up at the Crimean Astrophysical Observatory for assembly of the telescope; the premises were supplied with dried air from which every last speck of dust had been removed. They usually worked there only in twos. They changed their clothes in two procedures. First they removed their outer clothing in a "pre-dressing room" and wrapped themselves in regular cotton dressing gowns. Then on to the next room, where they donned nylon combination pants and boots completely covering their legs, and a gown that buttoned at the back. One their hands were rubber gloves carefully washed in alcohol.

The astronomers approached the matter seriously even in small matters. And for the comprehensive tests they used a total of six duplicate telescopes. And thanks to this they are now immensely happy: the enormous amount of preparatory work on Earth has been crowned with success in space. Technical checks on all the systems conducted by our specialists and by French specialists who took part in development of the ultraviolet telescope showed that they had withstood injection into orbit splendidly and were successfully operating in the severe conditions of space.

The check on the X-ray spectrometer developed at the USSR Academy of Sciences Institute of Space Research was also successful. The "Astron" is now opening a new chapter in the history of extraatmospheric astronomy.

Our apparently transparent atmosphere here on Earth lets only part of the electromagnetic radiation from the universe through to the Earth's surface. This is mainly visible light on which all traditional optical astronomy is based, and also a larger proportion of cosmic radio waves, which gave birth to radio astronomy. But all other windows on the universe are either completely "closed" by our atmosphere or only tiny cracks have been left open. In the ultraviolet range of the spectrum the Earth's atmosphere ruthlessly cuts off all radiation with a wavelength shorter than 300 nanometers (billionths of parts of a meter), leaving for the people only a small part of it, as if specially designed so that we do not burn up.

In fact it is only thanks to this that you and I can live here. Were it not for the powerful shield of the atmosphere the Sun's ultraviolet radiation would kill all living things on the Earth. But astronomers, even though they are an integral part of mankind, nevertheless grieve that by cutting off most ultraviolet radiation the atmosphere also cuts off the most valuable information about the universe. For it precisely within this range of wavelengths that the atmosphere absorbs that the majority of the spectral lines for the various atoms lie.

One of the founders of modern astrophysics, the well-known American astronomer G. Russell, wrote bitterly that the ultraviolet end of the spectrum of heavenly bodies was hopelessly closed for the astronomers. But only two years after his pessimistic conclusion studies of the Sun's ultraviolet radiation started with rockets, and later from aboard satellites and manned vehicles.

The special feature of the "Astron" is that, first, its ultraviolet telescope has a much larger effective collecting surface compared with all others sent into orbit up to now. Second, it has fine resolution down to one second of arc, to use the language of the astronomers. And so that we can understand what all this means, let us make a simple comparison: the "Astron" telescope is capable of distinguishing between two "Zhiguli" lights at a distance of about 200 kilometers.

This high resolution was achieved by an extremely cunning method. The "Astron" itself was developed on the basis of the "Venera" series of Soviet automatic stations. There the accuracy with which the stations could be guided was measured in minutes and even degrees. Now, however, it was necessary improve

this by a factor of 100. And this was done thanks to a cunning system of star tracking. The necessary accuracy on the "Astron" is achieved by a second mirror in the telescope which, as it were, compensates for all station oscillations within its capabilities of accurate orientation.

In order to understand how this is done, let us consider the entire passage of the light from distant stars that falls in the telescope tube. The circular diaphragms form a stream of parallel rays on the telescope's main mirror. Reflected from its concave surface, the convergent beam passes to the secondary mirror which has a focal length of 8 meters. From there the light is directed downward into the flare of a long blind mounted in the center of the main mirror. As it passes through this "hole" the light in the focus of the secondary mirror falls on the slit of the spectrometer and is split up into its spectrum and passed to photoelectric light receivers developed by French specialists. These make it possible to measure the energy of the radiation at each wavelength in three ultraviolet bands in the spectrum. The data obtained are converted and transmitted to the long-range space communications center. There they are recorded on magnetic tapes, which are already being processed at the computer center of the Crimean Astrophysical Observatory, and presented to the scientists in a form convenient for analysis.

Now, imagine that the light from the star at which the satellite is pointed deviates from the optical axis of the telescope because the station "yaws." The tracking system of the secondary mirror, developed by Armenian designers, immediately goes into operation. The light falling on the inlet slit of the spectrometer passes through the top of a miniature four-sided pyramid. Each of its sides selects just a little light for the photoelectric sensors whose signals are passed to a balance system. If the beam passes from the top of the vertical to the base of the pyramid, they extinguish it. But if the beam deviates, a misalignment signal is generated and a command is passed to the secondary mirror. It turns so as to direct the light along the required path. And so the oscillations of the massive station are dampened by the movements of the secondary mirror and high observation accuracy is insured.

The "Astron" started its observations with the constellation Taurus, known for its gigantic star Alderbaran and the bright Pleiades. The visual acuity of the eyes are usually checked with these. If a person can distinguish six stars in the silvery cloud of the Pleiades it means that he has good eyesight.

The "Astron" telescope also went through its own unique check for visual acuity, and the first research sessions showed that it is just fine. The developers of the telescope are overjoyed that this unique instrument is working so well.

"Ahead lies a big and complicated program of research on the universe in the ultraviolet and X-ray bands of the spectrum, and also with the aid of ground telescopes," says corresponding member of the USSR Academy of Sciences Aleksandr Alekseyevich Boyarchuk, the deputy director of the Crimean Astrophysical Observatory. "It will give us an opportunity for detailed studies of many processes taking place in the universe. And these are primarily nonsteady-state processes. And these are connected mainly with the double systems in

which material from one object flows into the other. The nature of this flow depends strongly on where the material is going--to a white dwarf, a neutron star or a black hole. Investigations in the ultraviolet make it possible to include the "outlying areas" of the observed phenomena, and their origin. On the other hand we shall be able to study without any kind of obscurity the coronas and photospheres of stars, that is, their outer shells, where most of the ultraviolet radiation comes from. Nature has arranged things so that in most elements the strongest resonance lines are concentrated in the ultraviolet spectral band. The 'Astron' telescope will make it possible to obtain information on the quantitative content of the various elements even if it is low. And this is very important for an understanding of which of the many possible paths will be taken by the thermonuclear reactions in the stars and how the heavy elements are formed, whose origin remains an enigma from the viewpoint of present theory. It is also possible for us to study the weak glow in interstellar and intergalactic space in the ultraviolet. A great deal remains unclear here. For example, individual bright areas have been detected, and we do not know what this means."

"Modern astrophysics is conducting studies right at the leading edge of science and virtually everywhere is touching on the area of the unknown." Andrey Borisovich Severnyy, the director of the Crimean Astrophysical Observatory, takes up the conversation. "Astronomical observations are now linked in the closest possible way with physics as they provide experimental material for theory and an understanding of fundamental problems of the existence of energy, space and time and the interconnection of the different physical fields. We still do not know, for example, the origin of the colossal energy in the explosion of supernovas or of the activity in the galactic nucleus. And perhaps just a small amount of material of fundamental importance, derived from astronomical observations in ranges that are new for us, could answer these and many other questions. Extraatmospheric astronomy is not eliminating but continuing ground astronomy and helping it by opening up new possibilities for researchers."

... Each night the visors of the helmetlike towers of the Crimean Astrophysical Observatory are opend up and the telescopes strain to see the same objects in the universe that the "Astron" is studying. Its telescopes are opening up those windows on the universe that are closed to the observatories on the ground. And it is important for the astronomers to compare the maps of the star worlds in order to understand the secrets of the heavens from which our planet's atmospheres cuts us off.

9642
CSO: 1866/128

'SPIKA' TELESCOPE ON 'ASTRON' SATELLITE DESCRIBED

Moscow PRAVDA in Russian 9 Apr 83 p 3

[Article by A. Severnyy, academician, and A. Boyarchuk, corresponding member of the USSR Academy of Sciences: "A Window on the Universe"]

[Excerpt] The Earth's atmosphere completely absorbs ultraviolet light and X-ray radiation (shorter than 300 nanometers), and taking telescopes beyond the limits of the atmosphere is the only feasible way of observing these radiations from space objects. During the last decade the following stellar telescopes have been put into orbit: "Copernicus" (United States), an international ultraviolet telescope, and the "Orion" telescope developed by Soviet scientists under the leadership of corresponding member of the Armenian SSR Academy of Sciences G. Gurzadyan. And now, the "Spika"--the largest of all these optical instruments--is operating in space.

The USSR Academy of Sciences Crimean Astrophysical Observatory has been conducting space experiments for more than 20 years. Thus, the first Soviet solar telescope, the OST-1, with a mirror diameter of 27 centimeters, making it possible to photograph the UV spectrums of Solar flares, operated aboard the "Salyut-4." Experience was gained here that made it possible to set about designing a large telescope to study the spectrums of stars in the UV. In addition to the specialist at the Crimean Astrophysical Observatory, scientists of the Armenian SSR Academy of Sciences and a number of industrial enterprises participated in the development and fabrication of the "Spika."

The "Spika" UV telescope was put into orbit aboard the "Astron"; the orbital apogee is 200,000 kilometers. The high-apogee orbit makes it possible to to make measurements more than 90% of the time outside the Earth's shadow and radiation belts.

The "Spika" is a two-mirror telescope. The diameter of the main mirror is 80 centimeters. The area of the working surface in the optical system is one-third greater than the American "Copernicus" telescope which was formerly the largest optical instrument in space. Both mirrors in the "Spika" have hyperbolic surfaces, providing a sufficiently large field of view with good quality images of stars.

The impressive overall dimensions (5 meters) and considerable temperature drop in space presented very strict requirements for the telescope's design, because a change of only 0.1 millimeters in the distance between the two mirrors leads to marked deterioration of the stellar images. In order to reduce the effect of temperature the mirrors were made from glass ceramic [sitall], a material that has virtually zero coefficient of linear expansion, while extensive use was made of Invar alloys in the tube structures. In other cases materials and design arrangements for components were selected so as to mutually cancel out the effects of temperature. The structure was tested in an altitude chamber.

The designers faced this question: how can the accuracy of the mirror surface (better than 0.1 micrometers with a diameter of 80 centimeters!) be maintained during its transportation, and particularly when the telescope is put into orbit? Special mountings were developed that held the mirrors firmly but did not deform the surfaces. In order to maintain the distance between the mirrors (alignment) a system enabling control of alignment was developed and mounted on the telescope.

Since the telescope is designed for observations of weak objects while there are very bright objects in space, such as the Sun, dealing with scattered light presented many difficulties. For this purpose the telescope components were specially treated, after which their reflection factor was only a few percent of the initial value. Complex machine computations helped to determine the dimensions and position of the limiters for parasitic light so that light from an interference source falling on the main focal point of the telescope after repeated scattering would be weakened by at least a factor of 1 million. The internal cavity of the telescope absorbs very strongly, and therefore it is impossible to permit solar rays to illuminate it; this would lead to excessive overheating. This is why light limiters are mounted on the outside of the telescope.

It is not a simple matter to retain the mirrors' high reflecting power. Both mirrors were covered with pure aluminum in vacuo and a thin layer of magnesium fluoride was then applied. Even a small amount of dirt falling on the surface of the mirrors can reduce the reflection factor in the UV range several times over. Therefore, only those materials that do not give off gases in the vacuum of space were used in the telescope. The telescope tube is sealed. After the components were mounted in the tube it was purged with dry nitrogen, which is neutral for optical surfaces. A special system maintained some excess pressure in the tube right up until the launch itself.

A UV spectrometer developed jointly with the Laboratory of Space Astronomy (France) was mounted in the telescope's focal plane; this is designed for photoelectric spectral recording using a scanning method in which a pallet with the photomultiplier is moved along the spectrum. A concave diffraction grating which breaks down the stellar rays falling on the spectograph into their composite parts is used in the spectrometer. The light receivers--three photomultipliers--enable measurement of radiation within the range 114 to 340 nanometers with high (0.04 nanometer) and low (1.4 and 2.4 nanometers) spectral resolution.

The spectrometer has three slits, making it possible to obtain spectrums for three types of object, namely bright stars (central 40-micrometer slit) and weak faint stars and extragalactic objects (a 0.4-millimeter slit), while the largest slit (3 millimeters) is used to study objects of great length such as nebulas and the galactic background. The recording system enables repeated measurement of the intensity of radiation in required parts of the spectrum lasting 0.5 of a second to tens of minutes.

The very crucial operation of stabilizing the telescope is done is two stages; the first, the coarser, is insured by the satellite's own regular system; the second, more delicate stage is done by turning the smaller mirror. When the image of the required celestial body shifts, star-position sensors signal the misalignment and drives return the smaller mirror to the required position.

A field-recognition camera, also developed jointly with French scientists, is used to identify the star fields. This is a small meniscus telescope that transmits an image to Earth where the star field within a 1-degree radius can be seen on a monitor screen.

Before the start of spectral measurements aboard the "Astron" station it is necessary to send a large number of commands defining the angles of turn for the telescope and operating modes for the spectrometer and star-position sensors and the numerous servo systems. The appropriate program is carefully prepared in good time. After it has been transmitted to the station observations with the UV telescope are done in the following sequence. The "Astron" station is turned and the telescope aimed at the object of interest with an accuracy of several minutes. Using the field-recognition camera the correctness of the aim is checked. If for any reason it is inaccurate the error is found, the turn angles computed, and the error corrected. If aiming has been correct the stars fall within the sensing field of the sensors. The telescope stabilization system turns the small mirror to "guide" the image of the object being studied into the required slit on the spectrometer. Then, on command from the ground, measurements are initiated and the results are immediately transmitted to Earth or first recorded by the onboard recorder. At the ground reception point information is recorded on magnetic tape. The data are then passed to the observatory computer center and processed.

The first session of scientific studies took place on 3 April. Stars in the constellation Taurus were observed

Thus, a start has been made on the planned research program using the "Spika" telescope mounted aboard the "Astron" station.

9642
CSO: 1866/127

STUDY OF HIGH-ENERGY ELECTRONS IN EARTH'S RADIATION BELT

Moscow IZVESTIYA in Russian 20 Apr 83 p 3

[Article by V. Kirillov-Ugryumov, professor, and A. Gal'per, professor: "A Surprise in the Radiation Belt"]

[Text] A quarter of a century ago the Soviet Union opened for mankind the pathway into space: the world's first artificial Earth satellite was put into orbit. One of the first outstanding achievements of science, which had obtained new possibilities for learning about the surrounding world, was the discovery of the Earth's radiation belt. Both the fact of the discovery itself and the clarification of the nature of the Earth's radiation belt belong to Soviet scientists, primarily the collectives led by academician S. Vernov and corresponding member of the USSR Academy of Sciences A. Chudakov.

The Earth's radiation belt is an extensive field in space filled with streams of charged particles held in the region of the planet by its magnetic field. Under the effect of this field quite complex movement takes place: coiling along the magnetic lines of force it oscillates between the northern and southern latitudes and "drifts" along the longitudes, moving around the Earth.

In shape the belt resembles a "boublik" [a ring-shaped bread roll--ed] with a cross section shaped like a "horn" that makes contact with the Earth's upper atmosphere in the northern and southern polar latitudes. The inner, concave edge of the radiation belt is quite well defined and at the equator is located at a distance of about 1,000 kilometers from the Earth's surface, while the outer edge (strictly speaking it has no precise boundary) stretches for tens of thousands of kilometers away from the planet. We note in passing that the height and inclination of the orbits of manned space vehicles and orbital stations are selected taking into account the configuration of the Earth's radiation belt so as to insure the safety of cosmonauts spending long periods in space.

The intensity of the proton and electron streams in the radiation belt and the energy of the particles vary considerably. We note merely that the highest-energy particles, the protons, (until recently it was thought that there were virtually no electrons in the belt with energies greater than several million electronvolts) are concentrated close to the inner edge of the belt. The outer

fields are occupied by low-energy electrons and protons. These fields are less stable and subject to transient changes. For example, the well-known aurora borealis is a glow in the upper layers of the atmosphere occurring when particles "spill over" from the outer part of the radiation belt under the effect of a magnetic storm.

This model of the radiation belt was constructed mainly on the results of experimental research done during the Sixties. Recently, thanks to the development of research methods and improvements in space technology, new experimental data have become available and the need has arisen to refine this model.

At the turn of the Sixties and Seventies the first indications were obtained that significant streams of electrons with energies of several tens of millions of electronvolts exist in the radiation belt. The staffs of the Moscow Institute of Engineering Physics and the Moscow State University Scientific Research Institute of Nuclear Physics conducted experiments with high-altitude aerostats which made it possible to record intense flashes of intensity in high-energy electrons. This phenomenon could have been connected with the electrons in the Earth's radiation belt that spill over into the atmosphere during magnetic disturbances. Attempts were then made to explain the nature of these electrons. In particular, an examination was made of the process of reaction between primary cosmic radiation and the residual atmosphere at a height of hundreds of kilometers above the Earth's surface, as a result of which high-energy electrons might occur and be held in the radiation belt by the magnetic field.

However, it was still not possible to conduct direct studies on high-energy electrons in the field of the Earth's radiation belt against the background of the enormous proton streams.

Early in 1979 the compact "Yelena-F" telescope, designed for recording both gamma quanta and high-energy electrons, was delivered to the "Salyut-6" orbital station by the "Progress-5" freighter. Together, cosmonauts V. Lyakhov, V. Ryumin, L. Popov, V. Kovalenok and V. Savinykh spent a total of more than 300 hours measuring electron streams and gamma quanta with the telescope's axis at various positions relative to the Earth's lines of magnetic force. In particular, numerous measurements were made when the station was passing over the field of the Brazilian magnetic anomaly where the Earth's radiation belt descends almost to the height of the station's trajectory. (The axis of the Earth's magnetic field and its axis of rotation do not coinicde with each other and so the radiation belt is asymmetric relative to the Earth, and it lies closest to the Earth's surface in the regions of Brazil and the South Atlantic). The telescope was able to record streams of electrons and protons. This made it possible for the first time to take direct measurements of streams of high-energy electrons in the radiation belt despite the fact that the total stream of particles is extremely great. The result was unexpected and interesting: a considerable proportion (up to 10%) of the total stream of high-energy particles that had earlier been thought to be protons, are, in the area of the Brazilian anomaly, electrons with energies greater than 30 million electronvolts. This is almost 20 times the intensity of high-energy electrons at the same height outside the radiation belt at the region of the equator.

As soon as the first measurements taken during the fourth main expedition to the "Salyut-6" had confirmed the existence of high-energy electrons in the radiation belt, the idea arose of taking measurements at considerably greater heights, much deeper in the Earth's radiation belt. The "Elektron" instrument, which is similar to the "Yelena-F" telescope, was developed for this purpose. The instrument was mounted on the "Intercosmos-Bolgariya-1300" satellite which functioned successfully in orbit for about 2 years. The main result from this experiment is apparent: high-energy electrons make up a substantial component of the inner field in the Earth's radiation belt.

Physicists greeted the lively interest the news that high-energy electrons had been found. The existence of high-energy electrons in the Earth's radiation belt was also confirmed by other researchers. Now the discussion is underway on the possible consequences stemming from this new natural phenomenon, which is of both purely scientific interest and also practical interest, connected with, for example, the radiation effects resulting from the reaction of streams of high-energy electrons with elements in the equipment of space apparatuses. And a new mechanism has been suggested for the formation of the high-energy electrons.

Obviously the next stage in this research will be a detailed study of the characteristics of the streams of high-energy electrons: spatial distribution (longitude, latitude, height), time characteristics, the connection with the status of the Earth's magnetic field and so forth. Of course, this is not a program just for a week or even a month. Special equipment will have to be developed and measurements taken on various kinds of space apparatus. A start has been made on the active realization of this program.

The "Progress-15" space "truck" has delivered a new version of the "Yelena-F" gamma telescope to the "Salyut-7" station. Although the telescope's name has been retained it has undergone considerable changes. Its modernization makes it possible to make a series of new measurements in the field of gamma astronomy and to continue at a higher qualitative level the measurement of electron streams. Interchangeable modules have been added to the main detection part of the telescope. Now different kinds of experiments can be conducted depending on which module is used.

One of the most important and interesting experiments is comprehensive measurement of the electron streams. And earlier, during the flight of the "Salyut-6", simultaneous measurements were taken of the electron streams with the aid of two identical instruments set up on the station and in a high-altitude aerostat. Later a unique opportunity occurred for taking simultaneous measurements from aboard the "Salyut-7" and the "Intercosmos-Bolgariya-1300" satellite. Electron streams can undergo considerable changes with time and this hampers comparison of results obtained at different times and different heights, and the aim of these measurements was to clarify the role of the time factor.

On 26 November 1982 the telescope aboard the "Salyut-7" was trained on the same position as the "Elektron" instrument aboard the "Intercosmos-Bolgariya-1300" satellite. The instruments were then switched on and for several hours simultaneous measurements were taken. On the same day, information from the "Intercosmos-Bolgariya-1300" satellite was transmitted back to Earth. When

cosmonauts A. Berezovoy and V. Lebedev returned to Earth after the longest space mission ever, they brought back with them the films with the information obtained by the "Yelena-F" telescope. During the time that the main expedition was aboard the "Salyut-7" a total of four sessions were conducted to measure electron streams and gamma quanta with the "Yelena-F" telescope. A methodological experiment was also conducted, making it possible to clarify the feasibility of using in a practical way in gamma astronomy the special collimation systems that substantially enhance angular resolution in telescopes. All the scientific information from both the "Salyut-7" station and the Intercosmos-Bolgariya-1300" satellite was passed to the Moscow Institute of Engineering Physics, where the usual painstaking work is going on to process and interpret the results; both scientific associates and students are taking part in this work.

It is possible that the results of this scientific work will draw back the veil from yet another of Nature's mysteries.

9642
CSO: 1866/129

UDC 521.6

OBSERVATIONS OF GEOSTATIONARY SATELLITES IN SPECULAR REFLECTED SUNLIGHT

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 3, Mar 83 (manuscript received 10 Aug 82) pp 181-183

YERPYLEV, N. P. and SMIRNOV, M. A., USSR Academy of Sciences Astronomy Council, Moscow

[Abstract] Observations of specular reflected sunlight from the surfaces of cylindrical satellites in geostationary orbit for the purposes of positional studies of these bodies is examined. It has been found that when geostationary satellites have solar panels, at particular orientations of the satellite relative to the Sun an observer on Earth is able to see specular reflected sunlight as bright flashes. When the cylindrical axis is stabilized in a direction parallel to the Earth's axis of rotation, specular light is spread within a narrow conical layer and observed brightness increases by 1-2 stellar magnitudes. The shape of this cone changes as a function of solar declination: in spring and summer its apex faces north and in fall and winter, south. Between 26 February and 13 April and between 31 August and 16 October when solar declination lies within the range $-8^{\circ}45'$ and $+8^{\circ}45'$ the conical layer opposes the Earth's surface. At this time lightspots can be observed from the earth's surface across a band about 340 km wide, intersecting the night half of the Earth. The duration of this most favorable observation time is about 1.5 days. Observation times are also affected by orbit inclination relative to the Earth's equator; calculations are shown for finding best observation times for satellites in inclined orbits. Dependencies for mean increase in stellar magnitudes are shown from photometric observations of geostationary satellites conducted in 1981. Figures 2; references 3: 1 Russian, 2 Western. [145-9642]

UDC 523.985

OBSERVATION OF QUASIPERIODIC PULSATIONS OF HARD X-RAYS IN SOLAR FLARES

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 5, May 83 (manuscript received 3 Dec 82) pp 307-311

BOGOVALOV, S. V., IYUDIN, A. F., KOTOV, Yu. D., DOLIDZE, V. I., ESTULIN, I. V., BEDRENNE, G., NIEL, M., BARAT, C., CHAMBON, G. and TALON, M., Moscow Engineering Physics Institute; Institute of Space Research, USSR Academy of Sciences, Moscow; Centre National d'Etudes Spatiales, Toulouse (France)

[Abstract] Results are presented from a search for periodicity in hard X-ray radiation in solar flares within the energy range 100 keV within time intervals of 1/32 of a second to tens of seconds. Data obtained from the "Prognoz-7," "Venera-12," "Venera-13" and "Venera-14" vehicles during joint Franco-Soviet experiments to study cosmic gamma-bursts using the SNEG-2MZ instrument were used for Fourier analysis. Solar flares used in the study all lasted no more than 1 minute and had a complex temporal structure. Results are shown from analysis of seven flare events recorded between 4 August 1972 and 20 November 1981. Two events on 5 November 1979 were recorded by two of the space vehicles, making it possible to show with a high degree of probability that in some solar flares hard X-ray radiation changes quasiperiodically with time; periodicity is usually of the order of several seconds. Figures 3; references 13: 5 Russian, 8 Western.
[156-9642]

UDC 523.94

SIMULTANEOUS DETECTION OF 160-MINUTE SOLAR PULSATIONS BY TWO RADIOTELESCOPES

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 5, May 83 (manuscript received 1 Nov 82) pp 312-315

NESTEROV, N. S., URPO, S. and KOTOV, V. A., Crimean Astrophysical Observatory, USSR Academy of Sciences, Nauchnyy Poselok; Helsinki University of Technology (Finland)

[Abstract] Simultaneous, independent observations were conducted in June 1981 at the Crimean Astrophysical Observatory (22-meter radiotelescope) and in Finland at the Helsinki University of Technology Radio Laboratory (13.7-meter reflector) in an attempt to reproduce results obtained by Scherrer et al. in 1980 showing solar pulsation with a 160-minute periodicity. An event occurring on 22 June 1981 and lasting more than 9 hours was simultaneously registered by the two instruments used in the experimental series; measurements were made of the differential (center-to-limb) solar radio brightness. Details of the observations are shown. Observation results show a 160-minute pulsation periodicity with synchronous variation of solar radio emissions within the period. Figures 1; references 8: 3 Russian, 5 Western.
[156-9642]

UDC: 523.985

ENERGY OF PARTICLES ACCELERATED IN SOLAR FLARES

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 9, No 2, Feb 83 (manuscript received 10 Jun 82) pp 125-127

KOCHAROV, L. G., Leningrad Polytechnical Institute imeni M. I. Kalinin

[Abstract] The energy spectra of electrons and protons observed in interplanetary space can be approximated over a broad range of energies above a few MeV/nucleon by the exponential function $dI/dE \infty E^{-\gamma-1}$, where in most cases $\gamma = 1.5\text{-}3$. Since attempts to calculate the total energy contained in particles with such spectra lead to an integral which spreads at the lower limit, at a certain minimum energy the exponential spectra must be cut off. It is difficult to judge the minimum energy for solar particles due to the great distortion of spectra in the energy area up to about 1 MeV after they are accelerated. The problem of experimental determination of the minimum energy is therefore quite significant for determination of the total energy contained in accelerated particles. A method is suggested in this article for computation of the minimum energy, based on the use of the anticorrelation of the spectral exponent and the flux of solar cosmic rays. Figure 1; references 12: 8 Russian, 4 Western.
[122-6508]

UDC 629

METHOD FOR CONSTRUCTING FAMILIES OF SPATIAL PERIODIC ORBITS IN HILL PROBLEM

Mowcow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 12 Oct 81) pp 787-807

LIDOV, M. L.

[Abstract] The necessary background for comprehending this study is an earlier article by the author in DOKLADY AN SSSR, Vol 223, No 6, 1977. There a new family $\mathcal{L}_\mu$ of spatial periodic orbits in the restricted three-body problem was defined. Later it was shown that an analysis of the problem in the Hill approximation can be used in the initial stage in detecting such orbits. (In such an approximation there is a family $\mathcal{B}_0$ of trivial periodic orbits when a point of negligibly small mass moves along a segment $0 \leqslant x_3 \leqslant x_{30}$ normal to the orbital plane of the main bodies, with the x_{30} parameter defining the orbit of this family). This article consists of 14 sections. Section 1 describes the KS transform since KS variables are used in computations and anslysis. Section 2 gives the derivation of equations in variations which are necessary is analyzing the stability of periodic solutions. Section 3 gives the formulas for the right-hand sides of the Hill equations. Section 4 gives the corresponding equations in variations for the right-hand sides of the corresponding

equations. Section 5 gives the algebraic expressions by means of which the fundamental matrix of solutions of equations in variations in the physical variables y, x is computed through the corresponding matrix in KS variables obtained using numerical integration. Section 6 gives all the canonical linear transforms of variables not changing the equations of the Hill problem. In section 7 it is shown how these transforms can be employed in the shortening of computations when determining periodic orbits and in corresponding solutions of equations in variations. Section 8 gives computational aspects of the stability problem. Section 9 presents a procedure for solving the boundary value problem for numerical determination of the orbital parameters of $\mathcal{L}_0$ families. Sections 10 and 11 outline analytical features of description of orbits of the $\mathcal{B}_0$ family in KS variables and numerical determination of $\mathcal{L}_0$ families close of $\mathcal{B}_0$. Section 12 then is a determination of the x_{30} critical values for $\mathcal{B}_0$ orbits for which in the neighborhood of the $\mathcal{B}_0$ orbit there are $\mathcal{L}_0$ orbits. Section 13 gives a procedure for solving this problem, defining the nature of behavior of orbits of the $\mathcal{L}_0$ family close to $\mathcal{B}_0$ in the neighborhood of the singularity $|x| = 0$. Finally, section 14 demonstrates the identity of some $\mathcal{L}_0$ families, making it possible to reduce the volume of computations in their search. References: 5 Russian.
[49-5303]

UDC 629.782

CHEBYSHEV APPROXIMATION AS SOLUTION OF MULTIPURPOSE PLANNING PROBLEM WITH ARBITRARILY CORRELATED MEASUREMENT ERRORS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 19 Jan 82) pp 808-820

BELOUSOV, L. Yu.

[Abstract] This is essentially a continuation of an earlier article by the author ("Multipurpose Planning Within the Framework of a Model of Measurement Errors With Arbitrary Correlation," KOSMICH. ISSLED. Vol 18, No 5, 1980). The investigation of multipurpose planning is dealt here in the sense of formulation of an acceptable measurement strategy, regardless of the type of purpose functions. The loss is minimized; it is equal to the maximum ratio of the evaluation of an arbitrary purpose function computed for the acceptable strategy to the same evaluation for an optimum strategy. This in essence involves further development of the theory of minimax evaluation within the framework of its formulation by M. L. Lidov ("A Priori Evaluations of Accuracy in Determining Parameters by the Least Squares Method," KOSMICH. ISSLED., Vol 2, No 5, 1964) for the purpose of developing the necessary methodology for determining an optimum experimental plan. The problem is reduced to the maximizing of the determinant using procedures similar to linear programming methods. An

evaluation of the parameters of the considered linear systems is accomplished by means of the Chebyshev approximation. The evaluations obtained by the proposed method and those obtained by traditional methods are compared. Specific examples are given. Figures 1, tables 1; references 9: 8 Russian, 1 Western.
[49-5303]

UDC 519.68

ALGORITHM FOR EVALUATING PARAMETERS OF RELATIVE MOTION OF TWO SATELLITES WITH FULL MEASUREMENT COMPLEX

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 2 Jun 81) pp 828-836

BERMISHEV, A. A., BRAGAZIN, A. F., SHMYGLEVSKIY, I. P. and SMOLKIN, P. I.

[Abstract] The authors describe a suboptimum algorithm for evaluating the significant parameters of relative motion of two satellites in semicircular orbits when a full range of measurements is made. The orbit of the passive satellite is assumed to be known, this making it possible to select the orbital parameters of the active satellite as those to be evaluated. The evaluation algorithm is formulated on the basis of the requirements of noise immunity and guaranteed reliability of functioning of the algorithm under conditions of an ambiguity in the structure of the measurement errors and rigorous restrictions on the volume of the memory and the productivity of the computer. It is assumed that information on the structure of measurement errors is incomplete. There is an in-depth discussion of problems relating to stability of the algorithm, its smoothing properties and noise immunity under conditions of its application. In the modeling procedure the purpose of the first stage was a rational choice of the numerical values of parameters of the evaluation algorithm, determining the weighting matrix in such a way as to ensure both the minimum time of convergence of the evaluations and an adequate degree of smoothing of the fluctuating components of the measurement errors. The second stage involves a comparison of the accuracy characteristics of the proposed algorithm and the Kalman filter. The proposed algorithm ensures the desired accuracy of evaluations even in the case of very large initial errors, such as up to 100 km in range. When applying this algorithm it is necessary to have a memory volume and speed several times less than when using the Kalman filter. The incorporation in the proposed evaluation algorithm of protection against the use of anomalous measurements and means for checking the reliability of the evaluations makes it extremely reliable. Figures 3; references 7: 6 Russian, 1 Western.
[49-5303]

UDC 531.38

POSITIONS OF EQUILIBRIUM OF A SATELLITE-GYROSTAT IN CIRCULAR ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82
(manuscript received 11 Dec 81) pp 837-847

SARYCHEV, V. A., BIRYUKOVA, M. P. and GUTNIK, S. A.

[Abstract] A study was made of the rotational motion of a satellite-gyrostat in a circular orbit under the influence of gravitational and aerodynamic moments. (The investigation is made in the coordinate system Oxyz, whose axes coincide with the main central axes of inertia of the satellite and the orbital system OXYZ; direction cosines are introduced for determining satellite orientation in the orbital coordinate system and the projections of the absolute angular velocity of the satellite onto the Ox, Oy, Oz axes are stipulated.) Under these conditions the authors ascertain the conditions for the existence of a unique stable position of equilibrium of a satellite-gyrostat with an aerodynamic stabilizer. The axis of the rotor, parallel to one of the main central axes of inertia of the satellite, in an equilibrium position is perpendicular to the orbital plane; the center of satellite pressure lies beyond its center of mass on the main axis of inertia, directed along the tangent to the orbit. The results of this investigation can be applied in ensuring an unambiguity of triaxial gravitational orientation of the satellite without the execution of complex maneuvers for changing the orientation of the satellite in orbit or introducing an active preliminary damping system. Figures 4; references: 8 Russian.
[49-5303]

UDC 533.601.18:550.388.2

TWO-DIMENSIONAL PROBLEM OF FORMATION OF PERTURBED ZONE IN NEIGHBORHOOD OF A PLATE IN A SUPERSONIC FLOW OF RAREFIED PLASMA

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82
(manuscript received 2 Oct 79) pp 848-858

SEMENOV, V. A.

[Abstract] A study was made of the problem of determining the parameters of the perturbed zone in the neighborhood of a space vehicle moving in ionospheric plasma, taking into account the influence of charged plasma particles and the electric fields arising in the neighborhood of the vehicle (magnetic fields are neglected). An electric field with the potential $\varphi(r)$ arises in the process of motion of the vehicle in the ionosphere. This field is caused by the electric charge of the body which is formed at the surface of the body and by the degree of "sweeping out" of electrons and positive ions by the body, as a result of which a space electric charge is formed behind the body. The electric fields forming as a result, being generated as a result of interaction between the body and the surrounding plasma, exert an influence on the

structure of the perturbed region. In examining the dynamics of the charged particles in the neighborhood of the space vehicle it is necessary to discriminate particles which collide with the surface of the object and those which do not collide. Such particles sense the presence of a body in the flow only through the electric field and if the body impermeable for particles is "removed" from the flow but the electric field arising during its motion is conserved, the dynamics of particles of the second kind can be investigated. Thus, the author examines the plane problem of the formation of a perturbed zone in the neighborhood of a long band moving at great supersonic velocity in Maxwellian collisionless plasma. A critical analysis of different approaches to solution to the problem is presented. Figures 5; references 7: 3 Russian, 4 Western.
[49-5303]

UDC 550.37

BOUNDARIES OF CAPTURE AND LOSS OF OUTER RADIATION BELT PARTICLES GOVERNED BY MAGNETOSPHERIC MAGNETIC FIELD

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 4 Aug 81) pp 866-871

SERGEYEV, V. A. and TSIGANENKO, N. A.

[Abstract] The authors have collected and analyzed data on the motion and losses of high-energy particles in the outer radiation belt ($L \geqslant 5$) caused by the configuration of the real magnetic field. These data are used for interpretation of the characteristics of fluxes of particles registered by a satellite at low altitudes. A semiempirical model is used which corresponds to quiet conditions whose principal advantage is a realistic reproduction of magnetic field characteristics in the equatorial region. The model was used in computing the necessary parameters: second adiabatic invariant and rectified trajectory for particles with different reflection points, periods of oscillation and drift around the earth, characteristics of the cone of ionospheric losses and cone of drift losses and radius of curvature of lines of force at the equator. Computations were made of the drift shells and rates of losses of energetic particles caused by pitch-angle scattering of particles at the time of intersection of the current sheet on the nighttime side. Data are given for numerical computations of angular scattering as a function of the ratio R_c/ρ. With $R_c/\rho \leqslant 10$ the amplitude of scattering during one intersection of the sheet increases sharply, the particles fill the cone of ionospheric losses and are scattered in the cone of drift losses. The final computations reveal that in the outer closed drift shells the losses have a characteristic time of about 1 hour for high-energy electrons, whereas the characteristic time for protons is considerably greater. Figures 4; References 17: 5 Russian, 12 Western.
[49-5303]

UDC 3.394.78

IONOSPHERE IN LOW AND EQUATORIAL LATITUDES AT ALTITUDE 500 KM DURING MAGNETOSPHERIC-IONOSPHERIC DISTURBANCES IN SEPTEMBER-DECEMBER 1977 (ACCORDING TO DATA FROM 'COSMOS-900' SATELLITE)

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 26 Apr 82) pp 872-880

GDALEVICH, G. L., VSEKHSVYATSKAYA, I. S., OZEROV, V. D. and SOBOLEVA, T. N.

[Abstract] During recent years considerable attention has been given to the discovery of clouds with sharp changes in concentration up to three orders of magnitude in the low latitudes in nighttime ("bubbles"). During the lifetime of these "bubbles" the convection of plasma into the regions of their existence differs sharply from the ordinary motion of plasma at nighttime. However, these findings must still be viewed with reservations because there are still few data on changes in the distribution of the concentration of charged particles in the low and equatorial latitudes during magnetospheric-ionospheric disturbances. Accordingly, the authors have used data collected by the "Cosmos-900" satellite on the concentration of positive ions at an altitude of about 500 km for investigating changes in ionospheric plasma in the low and equatorial latitudes during different phases of geomagnetic disturbances in September-December 1977. The analysis revealed that the appearance of inhomogeneities of concentrations is dependent on the rate of change of D_{st} variations, especially in the phase of magnetic storm restoration. The appearance of inhomogeneities in the region of maximum gradients of charged particles supports the hypothesis of a gradient-drift mechanism of their formation. The instabilities of plasma caused by its interaction with the ring current during its considerable changes are probably still another independent source of formation of inhomogeneities in the low latitudes. Figures 5, tables 1; references 25: 9 Russian, 16 Western.
[49-5303]

UDC 550.358

ION KINETICS, SMALL NEUTRAL AND EXCITED COMPONENTS IN D REGION WITH INCREASED IONIZATION LEVEL. I. FORMULATION OF PROBLEM AND GENERAL SCHEME OF PROCESSES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 11 Mar 82) pp 881-891

KOZLOV, S. I., VLASKOV, V. A. and SMIRNOVA, N. V.

[Abstract] The behavior of small neutral and excited components in the D-region with an increase in the ionization level was dealt with in earlier articles by S. I. Kozlov (KOSMICH. ISSLED., Vol 9, No 1, 1971) and S. I. Kozlov, et al. (KOSMICH. ISSLED. Vol 11, No 5, 1973). Expanding on this earlier work, the drawing extensively on the related literature, an effort is made to explain and resolve the qualitative and quantitative

differences obtained in different investigations and to clarify the overall picture. Particular emphasis is given to formulation of the problem for investigating ion kinetics, small neutral and excited components under these conditions. As a result it was possible to formulate a general scheme of the processes, and in particular, the constants of the reaction rates (an aspect of the problem which has resulted in considerable discrepancies in the findings) were clearly defined. The difficulties which arose in constructing this scheme are fully discussed and the means for overcoming them are outlined (solution of a large system of differential equations of chemical kinetics is involved). It is shown that this problem can be solved within the framework of a one-dimensional formulation. Subsequent articles will give a detailed analysis of the results of computations and their corollaries. Figures 1, tables 2; references 37: 9 Russian, 28 Western.
[49-5303]

UDC 535.568:523.14

DETERMINING ELECTRON CONTENT OF PLASMASPHERE USING COHERENT SIGNALS OF ATS-6 SATELLITE REGISTERED AT NEUSTRELITZ

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 26 Aug 81) pp 892-899

JAKOWSKI, N. and KUGLAND, H. G.

[Abstract] The problems involved and the methods employed in ascertaining the total concentration of plasmaspheric electrons by the reception of radio waves are discussed in the example of the ATS-6 satellite with reception at Neustrelitz, GDR. The authors demonstrate that it is possible to increase the accuracy in determining the total concentration of ionospheric electrons by the method of Faraday rotation of the polarization plane, provided that allowance is made for variations of the altitude of the F2 layer in the averaged weighting function $\overline{B}_{LF}$ of the geomagnetic field. Then the total concentration of plasmaspheric electrons N_p can be determined as the difference between the total concentration of electrons N_T measured along a ray trajectory between the satellite and the reception point on a differential basis (Doppler method) and the total concentration of ionospheric electrons N_F. It is important that if the B_{LF} value does not take into account the variations in the altitude of the F_2 layer the inaccuracy in determining the total concentration of plasmaspheric electrons will be as great as 20%. Under these conditions a totally valid determination of the diurnal variations of N_p can be made. Finally, the flows of plasma between the ionosphere and plasmasphere discovered on the basis of variations in the total concentration of electrons can be evaluated quantitatively. Figures 6; references 19: 1 Russian, 18 Western.
[49-5303]

UDC 550.385.41

OBSERVATIONS OF SOLAR WIND WITH HIGH TIME RESOLUTION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82
(manuscript received 15 Jan 82) pp 900-906

ZASTENKER, G. N., YERMOLAYEV, Yu. I., PINTER, S., NEMECHEK, Z., SHAFRANKOVA, Ya., BELIKOVA, A. B., LEYBOV, A. V., PROKHORENKO, V. I., STEFANOVICH, A. Ye., BEDRIKOV, A. G. and KARIMOV, B. T.

[Abstract] During 1980-1981, the Soviet-Czechoslovakian "Monitor" instrument was used aboard the "Prognoz-8" satellite for carrying out an experiment for studying plasma processes in the solar wind and geomagnetosphere with a high temporal resolution. The objective was to obtain continuous data on the behavior of the principal parameters of the solar wind (velocity, temperature, ion concentration and angles of incidence of flow) and a study of rapid changes in the energy spectrum of the ion component of the solar wind in the interplanetary medium and at the characteristic boundaries of the geomagnetosphere. The sensor used in measuring the total flow of ions and the angles of its incidence was a three-collector Faraday cylinder; the ion energy spectra were measured using cylindrical electrostatic analyzers. The ion detectors used in these analyzers are secondary photomultipliers of the open type. The "Monitor" in many ways is similar to the SKS plasma energy spectrometer but differs from it in the logic of operation. There was continuous measurement of the energy spectra of ions by scanning in the energy range 0.16-4.2 KeV/charge. The measurements were registered by two methods: in a regime of detailed measurements with counting of the number of pulses registered in each of the 32 logarithmically uniformly separated spectral steps and in a regime of monitoring measurements with processing of each spectrum with determination of three monitored parameters, making it possible to reduce the volume of transmitted information by a factor of 10 or increase the temporal resolution. The parameters used were the position of the spectral maximum (SM), height of maximum (HM) and the half-width of the spectrum in the direction of the low energies (SHW) at the level where the reading is less than the height of the maximum by a definite number of times. On the basis of the SM and SHW values it was possible to determine the velocity of the solar wind (with an accuracy to ~5%) and the temperature of protons (with an accuracy to ~50%) by means of a nomogram obtained as a result of model computations. Figure 1 is a block diagram of the "Monitor" instrument. Figures 5; references 8: 4 Russian, 4 Western.
[49-5303]

UDC 524.1-732

POSITION OF SOURCES OF SPORADIC RADIO EMISSION OBSERVED WITH 'ELEKTRON-2' AND 'ELEKTRON-4' SATELLITES IN FREQUENCY RANGE 0.7-2.3 MHz

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 11 May 81) pp 907-912

ARTEM'YEVA, G. M., MITYAKOV, N. A., PISAREVA, V. V. and TARASOV, A. F.

[Abstract] This article constitutes a reexamination and full analysis of available data on sporadic radio emission registered by the satellites "Elektron-2" (frequencies 725 and 1525 KHz) and "Elektron-4" (frequencies 1110 and 2293 KHz). These satellites directly intersected the postulated regions of emission or passed close to them (nighttime sector of the auroral magnetosphere at a distance of several earth radii and the region of the daytime polar cusp). The trajectories of the "Elektron-2" satellite were situated for the most part on the earth's nighttime side in the southern hemisphere; the "Elektron-4" was launched on the earth's daytime side (both had approximately the same orbital parameters). It follows from the data on the distribution of the mean intensity of sporadic radio emission in the frequency range 0.7-2.3 for the nighttime hemisphere that a distinguishing characteristic of the distribution in the evening hours (1600-1900 hours), premidnight hours (1900-2300) and the morning hours (0300-0800) is a positioning of the mean intensity maxima at geocentric distances $\sim$2-6 R_E and invariant latitudes $\sim$60-75°S. The time sector 2300-0300 hours stands out in that the emission is commonly observed at greater invariant latitudes and at greater distances. In the daytime hemisphere the sources at frequencies 1110 and 2293 KHz are most frequently in the region of the daytime polar cusp. The increased mean intensity values for daytime at frequencies 725 and 1525 KHz at small distances 1-2 R_E are best attributable to the natural noise of plasma in the upper layers of the ionosphere. For the daytime, evening and morning sectors the intensities of sporadic radio emission are small at invariant latitudes exceeding 78°; this latitude corresponds to the magnetic line of force extending into the tail of the magnetosphere. Figures 4; references 10: 1 Russian, 9 Western. [49-5303]

UDC 533.951.2

LOW-FREQUENCY NOISE DURING STRONG MAGNETIC STORM

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 14 Jun 81) pp 941-942

LARKINA, V. I., MAL'TSEVA, O. A. and NIKITENKO, T. V.

[Abstract] Electromagnetic low-frequency noise radiations and their variations during geomagnetic disturbances are characteristic phenomena accompnaying a magnetospheric storm. The characteristics of LF noise are related to the

spatial density distribution of medium- and low-energy particles and plasma fields. It is of particular interest to study the behavior of LF radiations and magnetospheric parameters during very strong disturbances, which are rare. The magnetic storm of 3 April 1979 was investigated, with noise observations during the main phase being emphasized. The "Intercosmos-19" satellite carried instrumentation suitable for registry of the magnetic and electric field components at frequencies 140, 450, 800, 4650 and 15,000 Hz, making it possible to study both components of plasmaspheric hissing and high-latitude phenomena and compare them with various geophysical phenomena. The distinguishing feature of LF noise emissions in the high latitudes is the appearance of amplitude fluctuations at disturbed times. It was found that the regions of registry of fluctuations coincide with the equatorial boundary of the diffuse injection zone. A close correlation between the region of the registry of fluctuations of the amplitude of the magnetic and electric components of the emission field and the boundary of diffuse leakage of soft electrons makes it possible to postulate that the emission source is situated somewhat above the plasmapause, possibly in the region of the boundary of diffuse leakage of soft electrons. Figures 2; references 4: 3 Russian, 1 Western.
[49-5303]

IMPORTANCE OF 'VENERA' MISSIONS TO PLANETARY STUDIES

Moscow PRAVDA in Russian 13 Jun 83 p 7

[Article by V. Barsukov, director, Institute of Geochemistry and Analytical Chemistry imeni V.I. Vernadskiy, corresponding member, USSR Academy of Sciences: "Through Space Into the Earth's Past"]

[Text] Two new Soviet interplanetary stations are on course to Venus. The nervousness related to the preparation of the scientific equipment and the craft themselves for the launching and injection of the "Venera" ships into their flight trajectories lies behind us now. The scientists will now have to wait until October, when the stations will approach that mysterious planet. Yes, it is still mysterious, even though science has learned more about it in the last 15 years than in all the previous centuries it was observed from Earth.

The scientific program for the new reconnoiterers of the Morning Star was created with due consideration for the data obtained by their predecessors. "Venera-15" and "Venera-16" will become artificial satellites of that planet and will study it as a whole. As is known, our stations have made landings in certain regions of Venus and have carefully studied its atmosphere and surface. It is now necessary to investigate in more detail the global processes taking place on this planet, particularly on its surface. The scientific equipment carried by "Venera-15" and "Venera-16" was designed especially for this purpose.

What is the reason for such great interest in studying Venus and the other planets in the Solar System? The fact of the matter is that it is possible right now for scientists to solve a whole series of fundamental scientific problems. This would have been impossible to do without improved spacecraft that were capable of reaching Venus, the Moon and Mars and landing on their surfaces or becoming artificial satellites of them.

In our time the planets and other objects in the Solar System are being converted quite rapidly from objects of interest to astronomy into objects of geological research, since, on the one hand, the study of them becomes impossible without the use of the methodology and accumulated knowledge of geology and, on the other, because the information (primarily about the planets in the terrestrial group) obtained in connection with this sheds light on the Earth's geological history, illuminating both the pages most difficult to read and those that are simply unreadable.

By studying terrestrial material alone, we obviously will never be able to decipher the history of the development of our planet during the first billion years of its

existence, since on Earth we simply do not find rocks more than 3.5 billion years old. However, we now know that the history of the formation and the early evolution of all planetary bodies of the terrestrial type were fundamentally similar. By studying the Moon, Mars and--especially--Venus, it is as if we are looking through the very first pages of the Earth's geological history!

Without knowledge of the past it is difficult to predict the future. And we cannot help but be troubled about the reasons why volcanic magmatism and tectonic life continued on the Moon from 4.6 to 2.8 billion years ago, whereas nothing of this nature has been manifested for the last 3 billion years. We know that on Earth and, apparently, on Venus this internal activity of the planets has let itself be heard from until the present and will still continue for quite a long time. An understanding of the causes of differing durations of the active lives of planets is absolutely not an idle question, since the development of the terrestrial biosphere is related directly to manifestations of volcanism and tectonic movements. It is very important to picture how the development of our planet will proceed further, whether or not its internal activity will increase or decrease, and--finally--how long it will continue. Truly, planets--as any other self-regulating systems--are born, live and develop, but at some time they die.

This depends on many causes, but we are beginning to understand more and more clearly that planets also have their own unique "genetic code," which is laid down during the birth of a planetary body, as it is being formed. It depends on the nature of the primeval matter from which the planetary body is formed, on its mass and size, on the distance from its sun and so on.

It is extremely important to understand the mechanism of the birth of planets, and this is impossible without studying the entire Solar System. This is why Soviet scientists are conducting a planned and purposeful study of the planets with the help of spacecraft and, in connection with this, are devoting their primary attention to the planets of the "terrestrial" group: Mars and--particularly--Venus and the Moon.

Scientists have long been looking for the answer to the question of the source of the energy that causes the heating of planetary nuclei until they partially melt (a temperature of more than 1,000 degrees is needed for this), with manifestations of volcanism and magmatism. Until the beginning of space research, the opinions converged in that the cause of the heating of planetary nuclei was the accumulation of heat liberated during the decay of natural radioactive elements. And this is apparently actually so, but its accumulation in the depths took place gradually and could cause the melting of the mantles of heavenly bodies only after approximately a billion years after their formation.

However, lunar soil was then delivered to Earth, and a study of the first samples of rocks from the "continental" part of its surface revealed that they were formed from a magmatic 4.0-4.6 billion years ago; that is, during the final stage of the formation of the Moon as a heavenly body, when the heat from radioactive decay was still not high enough to insure melting of the lunar mantle.

For the first time in geological practice we ran into a powerful combination of the processes of gravitational compression of young heavenly bodies and the explosive impact effect on their surfaces of an intensive meteor bombardment, which is typical

of the final stages of their formation. The subsequent study of Mars showed that a combination of these processes is typical in the formation of planets.

The explosive impact process, which leads to the formation of the primary, planetwide, "continental" crust, turned out to be new to scientists. The possibility of its manifestation in the history of the formation of the Earth had not previously been considered.

Another extremely important result of the study of the planets in the terrestrial group was the establishment of the fact of the appearance, synchronously with the Earth, of early (3.6-3.8 billion years ago) basalt melts caused by the accumulation in the mantle of heat from radioactive decay. These melts have clearly accumulated on the previously formed primary, planetwide, "continental" crust. In connection with this, the preservation on the surface of the primary "continental" crust is decreasing, whereas both the degree of its coverage by basalts and the duration of basalt volcanism increase as the size of the heavenly body does (16 percent on the Moon, 50 percent on Mars).

If this relationship is applied to the Earth and Venus, which are both larger, it turns out that the primary "continental" crust should be practically absent from their surfaces, having been covered completely by basalts 3.0-3.8 billion years ago. Moreover, on the Moon and Mars the total thickness of the crust in regions where the primary "continental" crust is covered by basalts should, it would seem, increase, but according to geophysical data it actually decreases sharply: from 70 to 30 km on the Moon and from 30 to 10 km on Mars. This means that--at least in regions of subsidence or downwarping of the crust--the geophysical interpretation of the deep structure of planetary bodies does not correspond to the geological interpretation and still cannot be used directly to determine the boundaries between rocks with different compositions.

All of this has raised forcefully a whole series of fundamental problems concerning the Earth's geological history and underlined the need for taking comparative planetological analysis into consideration when deciphering it. This means that in the future, also, it is necessary to persist in our study of the heavenly bodies in the terrestrial group.

In 1967, for the first time, the Soviet automatic "Venera-4" station descended smoothly into the Morning Star's atmosphere. Since then we have learned much about the composition and structure of Venus's atmosphere. The next important step in the study of that planet was the soft landing on its surface that was made by "Venera-7". Subsequent descent vehicles made safe landings on its surface. However, it may be that the most difficult and impressive experiments were those conducted on Venus more than a year ago by the "Venera-13" and "Venera-14" stations.

The achievements of Soviet cosmonautics are being placed at the service of world science. Only 2 weeks after the landing of our stations on Venus, Soviet scientists reported the results obtained at an international conference on the study of the Moon and planets that was held in Houston, in the United States. This is what the NEW YORK TIMES wrote on that occasion: "The successful operation of the Soviet stations was the 'hit' of the recent 13th Conference on Questions of Lunar and Planetary Research. When the photographs of Venus's surface were shown to 560 scientists (most of them American), cries of 'Oho!' and 'Aha!' rang through the hall...As

Robert (Pepin), a physicist from the University of Minnesota, said, 'There was more than just a little bit of envy on our part.' However, there was also a great deal of admiration."

The Soviet scientists and designers, of course, were quite flattered to hear the high evaluations of their work. This was not the main thing, however. I think that these statements once again confirm that science--including American science--has developed and is developing in large part because of international cooperation and the extensive exchange of opinions and ideas. "Sanctions" and "restrictions" of all kinds harm primarily the scientists from the country whose government attempts to impose them.

Our country's achievements in the investigation of space have always been placed at the service of all mankind. The results that our scientists hope to obtain with the help of the "Venera-15" and "Venera-16" interplanetary stations will be no exception...and those stations are already on their way.

11746
CSO: 1866/148

UDC 523.42

VENUSIAN UPPER CLOUD LAYER AND OVERHEAD HAZE: A REVIEW

Moscow ASTRONOMICHESKIY VESTNIK in Russian Vol 17, No 2, Apr-Jun 83
(manuscript received 9 Jul 82) pp 67-81

KSANFOMALITI, L. V., USSR Academy of Sciences Institute of Space Research

[Abstract] Photometric studies of the Venusian cloud cover conducted in the UV range are reviewed. The cause(s) of absorption at 270-350 nanometers are discussed and the various explanations considered. The photometric characteristics and relative position of contrast bands are examined in the light of data obtained from the Mariner-10, Pioneer-Venus, "Venera-9" and "Venera-10" probes. The problems of interpreting contrast profiles are considered for the cases of the sunrise and sunset terminators. The properties and dynamics of the upper cloud layer are discussed using radiometric, polarimetric, and photometric data. In general, the following conclusions can be drawn about the nature of the Venusian cloud cover: at night the cloud cover is sharply defined at a height of about 70 km, but is not sharply defined at day, when the aerosol concentration reaches as high as 83 km; the aerosol is stratified near the sunrise terminator; brightness varies as a function of the diurnal cycle; the refractive index is associated with the presence of sulfuric acid particles in the upper cloud layer; data indicate that coagulation and coalescence play an insignificant role in particle dispersion; rapid clarification of the overhead atmosphere not associated with aerosol settling is observed after sunrise. Figures 12; references 35: 10 Russian, 25 Western. [155-9642]

UDC 629.785:523.42

VENUSIAN STRATOSPHERE ACCORDING TO DATA FROM ACCELEROMETRIC MEASUREMENTS ON 'VENERA-11' AND 'VENERA-12' AUTOMATIC INTERPLANETARY STATIONS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 26 Apr 82) pp 913-920

AVDUYEVSKIY, V. S., SEMENCHENKO, V. V., USPENSKIY, G. R. and CHEREMUKHINA, Z. P.

[Abstract] Observations were made of the Venusian stratosphere during descent of the "Venera-11" and "Venera-12" probes in a sector where the accelerations exceeded 100 g and the temperature was several thousand degrees. Accordingly, it was difficult to measure thermodynamic parameters with traditional temperature and pressure sensors. A special feature of these experiments was that there was no transmission of telemetric data, thus making it necessary to employ a complex electronic block in the measurement system. The shortcomings of earlier experiments of this type were remedied. The improved "BIZON-M" system was used: this included two primary converters of linear accelerations (axial and lateral acceleration accelerometers), a control unit and a block for converting, processing and accumulating data. The memory capacity of the "BIZON-M" was considerably greater and the interrogation rate was 4 times a second. The operation of the measurement system is described. This high measurement frequency made it possible to analyze the dynamics of motion of the probes in the preparachute segment, refine the ballistic prediction of the parameters of the trajectory for entry into the atmosphere and retrieve the profile of density of the Venusian upper atmosphere. At an altitude of 67-68 km there was evidence of passage through the upper boundary of the cloud layer. The measured $n_*(t)$ curve makes it possible to bring it into accordance with the computed atmospheric density values as a function of altitude in the range 65-100 km. The increased rate of measurements made it possible to detect fine effects. This was accomplished by solving the nonlinear inverse ballistic descent problem by integration of a system of differential equations by the Runge-Kutta method with a vertical interval ensuring the required accuracy. Figure 3 shows the constructed pressure and density profiles; Fig. 4 shows the vertical temperature profile. The accumulated experimental data make it possible to describe the physical structure of the Venusian upper atmosphere and construct models for the stratomesospheric region taking diurnal-latitudinal variations into account. Figures 4; references 11: 6 Russian, 5 Western. [49-5303]

UDC 551.54:523.43

RELIEF OF MEMNONIA FOSSAE-MARGARITIFER SINUS REGION ACCORDING TO DATA FROM CO_2 ALTIMETRY ON 'MARS-5'

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82 (manuscript received 30 Dec 81) pp 921-927

ZASOVA, L. V., ZUBKOVA, V. M., ZHEGULEV, V. S., KSANFOMALITI, L. V., MOROZ, V. I. and PETROVA, Ye. V.

[Abstract] The trajectories investigated in an experiment with the "mars-5" passed 15-30° to the south of the gigantic rift valley Marineris Valles. These trajectories began at the point of intersection of the western limb by the optical axis of the instrument on the southwestern margin of the area of the Tharsis volcanic cones in Memnonia Fossae. They then passed through the Claritas Fossae mountain ridge and the southern part of Solis Planum to the northern wall of Argyre crater lake, intersecting the Nirgal Vallis region, after which they reached northward to Margaritifer Sinus and ended in the Pyrrhae Regio region. The authors describe altimetric measurements along these trajectories on the basis of relative photometry in the saturated rotational-vibrational bands of CO_2 at 1.961, 2.013 and 2.052 μm and in the parts of the continuous spectrum near 1.919, 2.043 and 2.27 μm. The principles for determining relief elevations on the basis of the intensity of the CO_2 bands were described earlier by L. V. Ksanfomaliti, et al., in KOSMICH. ISSLED., Vol 13, No 4, 1975. The instrument discriminated a field of 30', which with a mean distance of the vehicle from the planetary surface at pericenter of about 1,800 km gave a resolution of 18 km (at the edge of the trajectory about 33 km). The measurements gave the thermal properties of the ground, the characteristics of surface structure, its photometric characteristics and relief. The altimetric data indicated drops of elevation of 6 km or more on a base of 50 km (Claritas Fossae). On the other hand, the region of Holden-Hale and Nirgal Vallis craters is an extensive plain. Figures 5; references 15: 9 Russian, 6 Western.
[49-5303]

EFFECTS OF WEIGHTLESSNESS ON COSMONAUTS

Leningrad LENINGRADSKAYA PRAVDA in Russian 5 Mar 83 p 2

[Article by V. Kopanev, doctor of medical sciences, professor, entitled "How Do You Feel, Cosmonaut?"]

> [Text] K.E. Tsiolkovskiy's statement that "mankind will not forever remain bound to the Earth.... but will master the space of the solar system" is being increasingly confirmed in our time. More than 100 people have now completed space flights, more than half of them representatives of the USSR and the countries of the socialist community. However, only the first steps have been taken by the men of Earth in mastering the space of the solar system, and many difficulties lie ahead before Man's cherished dream comes true. The difficulties are not only of a technical nature; there are other problems, including, for example, those associated with the conditions of weightlessness. In this article published today we talk about the problems that space medicine encounters in the human body in space.

During the process of a long-duration space flight and the associated long period of weightlessness, changes are noted in the cardiovascular systems of the cosmonauts. When at rest, and especially during sleep, blood pressure drops quite perceptibly and the heart rate slows. All these phenomena are explained by many causes, but primarily by the disappearance of weight from the blood.

In and of itself, this is not so fearful for the body, but as the result of the prolonged effect of weightlessness on it, signs of atonia of the heart and vascular system and of reduced reserves are seen. This becomes particularly obvious when cosmonauts have to carry out work during a flight and when they are returning to Earth.

Under weightless conditions, as the result of the disappearance of the blood's weight, it pools in the major vessels in the chest, and the body reacts to this by increased excretion of fluids. As a result, the cosmonauts lose a certain amount of weight which, however, is regained quite rapidly after returning to Earth.

What can be said about the individual's subjective feelings in space? Yuriy Alekseyevich Gagarin talked about a "feeling of discomfort associated with the absence of pressure on the back such as an individual feels when sitting in an armchair." During the first minutes of weightlessness other cosmonauts have had a sense of flying in an inverted position, and changes occur in appetite (they have the desire for spicy food); and visual acuity and the perception of color have been altered, and so forth. All this is explained one way or another by the impairment of the interaction of the analyzers insuring orientation in space, formation of the correct posture and so forth, under weighltess conditions. Such phenomena are often accompanied by the development of a state of motion sickness first described by G. S. Titov. The space form of motion sickness has much in common with regular "sea sickness" or "air sickness," but in all cosmonauts the sickness progresses much more mildly.

During space flights the conditions in which human bone tissue functions change sharply. In a state of weightlessness the motor function of the entire skeletal apparatus is virtually zero, as a result of which substantial changes take place within it. Minerals are excreted strongly from the bone tissue. According to U.S. researchers, in some cosmonauts flying with the Gemini and Apollo programs, bone saturation with minerals sometimes dropped up to 23 percent. Soviet scientists have obtained roughly the same kind of data.

True, the demineralization process depends on many factors, but it is primarily prolonged weightlessness and the nature of the diet, and also the motor activity of the cosmonaut. According to U.S. specialists, this kind of loss of minerals from the body is harmless and is quite acceptable for a period of several years. Soviet scientists, however, are in favor of taking steps to prevent excess excretion of minerals.

Thus, the facts cited above indicate the obvious changes taking place in the human body in space. As a rule, however, all cosmonauts, without exception, manage to cope fully with the extremely full flight programs. They have worked with movie cameras and traps for meteorite particles and they have carried out a mass of other important and essential work. It is simply that during flight training all the cosmonaut's actions are brought to a high degree of automation. The equipment itself and the methods for using it also help an individual to work in space.

Here we are talking about only the most important and well-studied changes that take place in the bodies of cosmonauts under weightless conditions. Undoubtedly there are many more, since man is in essence greatly affected by the factor of evolutionary adaptation to life and activity on his own planet under the conditions of terrestrial gravitation. However, in our day-to-day life we are so accustomed to the constant stimulus of, for example, city noise, that often it is not noticed. It is possible that in time, something similar will be observed among those who go on frequent space flights and periodically encounter weightless conditions.

At the same time, Soviet specialists in the field of space medicine are not sitting on their hands waiting for the results of natural adaptation by man

to unusual conditions. They have conducted a large amount of research on the prevention of the adverse effects of weightlessness on the bodies of cosmonauts and terrestrial gravitation after they return from a flight.

The solution to this problem, which is extraordinarily important for man's mastery of space, is being sought along several avenues. First, by improving space vehicles technically, and second, by developing various devices that prevent the adverse effects of weightlessness on the body. Progress in rocket design is making it possible to develop the kind of vehicles in which it is possible to support the conditions essential for human hygiene. Equipment with which the cosmonaut works is being improved. And finally, one radical solution to the problem is to develop a space vehicle in which man will be artificially rid of the discomfort of weightlessness. This could be achieved, for example, with the aid of rotating vehicles.

When speaking about human health in space, we must not, of course, forget such specifically medical aspects as the improvement of functional and compensatory possibilities aimed at enhancing the cosmonaut's resistance. Many people are probably aware of the great significance of physical training for cosmonauts during flight; this not only creates positive feelings in the individual and enhances his work capacity, but also prevents muscle atrophy (especially of the antigravitational musculature) and loss of minerals from bone tissue and helps in rapid adaptation of the body after the return to Earth. Special training for the human vestibular apparatus, on which the body's resistance to motion sickness depends, is also important. The program for this training is worked out specifically for each flight and takes into account its duration, the makeup of the crew and so forth.

On the recommendation of physicians, a number of devices and instruments have recently been developed that should help cosmonauts' health directly during flight.

Thus, on the "Salyut" orbital station the cosmonauts used the "Chibis" vacuum suit which creates a strong load along the longitudinal axis of the human body. As a result, weight is simulated and blood pools in the lower part of the body as it does in man when he assumes the vertical posture on Earth.

Promising results have been obtained in the action of accelerations on the human body; these are obtained with the aid of a centrifuge with a short radius of about two meters. Such centrifuges can be installed in space vehicles and switched on periodically. There is a growing number of advocates in favor of special g-suits that create pressure on the human body. Such suits have already been tested under the conditions of the "Salyut" and were highly assessed by the cosmonauts.

Man in space. Strictly speaking, this phrase is still symbolic in nature. Man has penetrated only into the space around the earth and has taken only his first step into the great universe. But it is an important step because it is precisely here, at this present stage in space research, that man is encountering the conditions quite unusual for the men of Earth. And the further success of space expeditions will depend on how well he prepares for and adapts to these conditions.

9642
CSO: 1866/86

UDC 581.521

INFLUENCE OF RADIATION FACTOR ON OPERATOR ACTIVITY

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82
(manuscript received 22 Oct 81) pp 928-940

DAVYDOV, B. I., ANTIPOV, V. V. and USHAKOV, I. B.

[Abstract] Ionizing radiation is one of the factors considerably impairing the functioning of an operator. In most general form, the performance of an operator is determined as a function of four principal arguments: physical state of operator, psychic status, complexity of work done and the conditions under which it transpires. The principal feature of quantitative evaluations of the level of performance under the influence of ionizing radiations is their probabilistic character. At present there are no probabilistic indices of the level of performance and no data on changes of these indices under the influence of flight factors either individually or in combination with ionizing radiation. This article is a review of the problems in radiation psychophysiology, based largely on non-Soviet literature. Three sections are devoted to: indirect evaluation of performance on the basis of data from clinical investigations; psychophysiological investigations of irradiated persons; experimental investigations on animals with extrapolation to man. However, emphasis is on an analysis of behavioristic effects in irradiated monkeys with such tests as teaching and retention of discrimination skills, transfer of skills to new situations, postponed reactions, attention, manipulation of objects, solution of mechanical puzzles, and others (the results of these studies are reflected in a two-page table). The dose and time parameters of reactions are examined in relation to irradiation conditions. The authors conclude on the basis of the analyzed data that an impairment of a cosmonaut's performance would occur only with very high irradiation doses whose probability of occurrence would be extremely low even during very prolonged flights. Tables 2: references 47: 8 Russian, 39 Western.
[49-5303]

UDC: 612.821.6

STATUS OF INTERNAL INHIBITION PROCESSES IN RATS DURING FLIGHT ON THE COSMOS-1129 SATELLITE

Moscow ZHURNAL VYSSHEY NERVNOY DEYATEL'NOSTI IMENI I. P. PAVLOVA in Russian Vol 33, No 1, Jan-Feb 83 (manuscript received 9 Mar 82) pp 26-31

APANASENKO, Z. I., KUZNETSOVA, M. A., MEYZEROV, Ye. S. and SEROVA, L. V., Moscow

[Abstract] An analysis is presented of the specifics of conditioned reflex activity during space flight to determine the functional processes most sensitive to space flight factors. Experiments were performed on male Wistar rats weighing 300-320 g. Three groups of five were included, the experimental group and two control groups. The experimental animals spent 18.5 days onboard the Cosmos-1129, the control animals spent the same time on board mockups of the descent apparatus. Parameters of previously developed feeding reflexes in response to light signals were recorded. Two positive signals and one differentiated signal were used. Response reactions were judged on the basis of motor feeding activity of the animals around the food container. Photosensors were used to record this motor activity on magnetic tape. A significant weakening of the process of internal inhibition was observed manifested as deinhibition of differentiation and an increase in the number of reactions between signals. The daily rhythm of feeding motor reactions between signals was disrupted during the flight, also probably resulting from defective inhibition. Sensitivity of conditioned reflex parameters related to internal inhibition processes to space flight factors allows them to be used for early indication of developing changes. References 18: 12 Russian, 6 Western.
[125-6508]

SPACE ENGINEERING

UDC 629.78

RECURSIVE-ITERATION ALGORITHM FOR SOLVING CHARACTERISTIC EQUATION OF STABILIZED SPACECRAFT. II

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 20, No 6, Nov-Dec 82
(manuscript received 12 May 82) pp 821-827

RABINOVICH, B. I., LEBEDEV, V. G., KALININA, A. V. and NARKUNSKAYA, G. S.

[Abstract] Part I of this study appeared in KOSMICH. ISSLED., Vol 20, No 4, 1982. In this second part the authors give a brief description of the programmed application of a recursive-iteration algorithm in FORTRAN language. The required set of programs is developed in the form of the integrated ANNRI program. In developing this program there was adherence to the following hierarchy of priorities: maintaining accuracy--volume of memory used--computation time. The program provides for use of all modern channels for the transmission and storage of information (automatic digital printout unit, disk, magnetic tape, alphabetical-digital and graphic displays, curve plotter) and different information levels (shortest, intermediate, most complete) and also information on emergency and pre-emergency situation with corresponding diagnosis. In a number of test problems for different objects with many degrees of freedom the authors present a comparative evaluation of the RI algorithm and the QR algorithm closest to it in possibilities. More than 200 test problems are considered, including all the special and difficult cases enumerated in the first part of the investigation. An example is cited for illustrating the practical use of the ANNRI program in investigating the dynamic stability of a space vehicle with a liquid-fuel engine with two fuel tanks in the active segment of its trajectory. Tables 4; references: 3 Russian.
[49-5303

UDC 551.243.13:629.78(282.251)

EXPERIENCE IN USING SPACE PHOTOGRAPHS FOR COMPILING MAPS OF PERMAFROST AREAS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 13 Apr 82) pp 14-20

NEKRASOV, I. A. and PETROPAVLOVSKAYA, M. S., Institute of Permafrost Studies, Siberian Department, USSR Academy of Sciences, Yakutsk

[Abstract] The use of space photography to help in the compilation of maps of permafrost areas is reviewed. Work done at the Institute of Permafrost Studies using photographic material obtained from the "Soyuz-22" is described: an MKF-6 camera was used to produce black-and-white pictures of the Vilyuy River basin from which 1:1,000,000 maps of the permafrost were compiled. Details of the photographic equipment and interpretation methods are given. Map compilation is based on comparison of space pictures with known elements of the relief and plant cover elucidated during field studies in permafrost areas. A correlation was found between relief and the rock temperature. Black-and-white photographs in the visible range are suitable for determining the temperature of permafrost formations with minimum ground and aerial observations. Earlier work on permafrost map compilation is reviewed and compared with results obtained from space photographs. In the interpretation of space photographs of permafrost areas, the height of the region, the kind of relief, plant cover, soil and geological features, surface moisture and rock temperature should all be considered; great significance attaches to seasonal variations in these parameters. Figures 3; references 12 (Russian). [119-9642]

UDC 551.49:629.78

EFFECTIVENESS IN USE OF SPACE PHOTOGRAPHS IN HYDROGEOLOGICAL STUDIES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 4 Jun 82) pp 21-26

BURLESHIN, M. I. and SADOV, A. V., All-Union Scientific Research Institute of Hydrogeology and Engineering Geology, Moscow

[Abstract] A series of experiments was conducted to determine the effectiveness of using space photographs in hydrogeological cartography and the findings

were analyzed to establish the position of space photography in this work in terms of economic effectiveness, on the premise that rapid interpretation of material is a major factor. The effectiveness of compiling hydrogeological maps from large- and medium-scale space photographs, aerial photographs, and a combination of the two types of materials was analyzed and compared from the standpoint of four hydrogeological tasks, namely, establishing the properties of the geological medium and ground water, mapping the geological medium and ground water, tracing changes in the properties of the geological medium and ground water, and hydrogeological zoning. It was found that when space photographs are used for large-scale hydrogeological mapping their effectiveness is sharply reduced; basic interpretation is better done using aerial photography, while space photography should be used only for zoning. Formulas are shown for calculating the economic effectiveness of space photography in hydrogeological mapping, and specific numerical examples of their use are shown. The results indicate that space photography can be effectively used to resolve hydrogeological mapping problems and that its use is economically justified. Figures 1; references: 8 Russian.
[119-9642]

UDC 631.47+581.5:629.78

IMPROVING ACCURACY OF SOIL AND GEOBOTANICAL ZONING DIAGRAMS USING SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 9 Jun 82) pp 27-37

GOROZHANKINA, S. M. and KONSTANTINOV, V. D., Institute of Forestry and Wood imeni V. N. Sukachev, Siberian Department, USSR Academy of Sciences, Krasnoyarsk

[Abstract] Using as an example the West Siberian Plain, a study was made of the effectiveness of using space photography to improve the accuracy of soil and geobotanical zoning diagrams compiled using traditional methods. The details of the northern, central and southern taiga areas in the West Siberian Plain, and their intermediate zones were examined and compared with diagrams compiled earlier. It was found that visual data enable good determination of the horizontal structure of the soil and plant cover, which provides more detail on natural delineation. This, in turn, makes it possible to establish inaccuracies in earlier diagrams. Details are provided. It is concluded that space photographs offer a sound basis for the compilation of soil and geobotanical zoning diagrams and that information from such material can fill in many of the gaps left by ground methods, making it possible to improve the accuracy of zoning diagrams. Figures 2; references 29 (Russian).
[119-9642]

UDC 551.321.7+551.576.2

IDENTIFICATION OF SNOW COVER AND CLOUD COVER FROM SPACE MEASUREMENTS OF SPECTRAL BRIGHTNESS IN NEAR-INFRARED

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 1 Oct 82) pp 38-42

VEYSMANN, U. K., VILLMANN,, Ch. Y., GRECHKO, G. M. (pilot-cosmonaut of the USSR), ROMANENKO, Yu. V. (pilot-cosmonaut of the USSR), TYNNISSON, T. A. and EERME, K. A., Institute of Astrophysics and Atmospheric Physics, Estonian SSR Academy of Sciences, Tartu

[Abstract] Findings are presented from near-infrared measurements of spectral brightness of the Earth's surface made during the period December 1977-March 1978 from aboard the "Salyut-6" in order to investigate the feasibility of identifying snow and cloud cover from pictures taken at these wavelengths. Measurements were made at wavelengths of 1.32, 1.62, 2.20 and 2.35 nanometers over North Africa, the Mediterranean, the steppe territory of the USSR and South America using an MKF-6M camera and a "Mikron" four-channel radiometer. A comparative analysis of results from the four different wavelengths was made in order to establish whether cloud cover could be distinguished from snow cover with the Sun at various zenith angles. At wavelengths of 1.32 and 1.62 nanometers the spectral brightness was less than unity in the absence of a snow cover and greater than unity when a snow cover was present. For cloud cover, the value of the relationship $B_{1.32}/B_{1.62}$ depends on the predominance of either water droplets or ice crystals in the cloud, but no unambiguous pattern could be distinguished. Figures 2; references 7: 6 Russian, 1 Western. [119-9642]

UDC 634.434+551.4.5634.11

USE OF SPACE PHOTOGRAPHS TO ASSESS DAMAGE FROM FOREST FIRES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 30 Jun 82) pp 43-49

FURYAYEV, V. V., KIREYEV, D. M., SUKHIKH, V. I. and ZHIRIN, V. M., Institute of Forestry and Wood imeni V. N. Sukachev, Siberian Department, USSR Academy of Sciences, Krasnoyarsk; All-Union "Lesproyekt" Association, Moscow

[Abstract] The feasibility of using space photographs to assess damage from forest fires was studied in light of the inadequacy of available ground methods. Space television pictures and survey and smaller-scale thematic and topographical maps were used to clarify natural boundaries and the morphological structure of the landscape, and the natural territorial complexes were assessed on the basis of various natural classifications from the actual condition of forest areas following repeated forest fires over a period of many years. A comparative analysis was made of the usefulness of space

photographs and aerial photographs. Forest recovery and growth and changes in the main forest cover were evaluated, and calculations were made of degree of damage from forest fires. Formulas are shown for calculating damage to timber stands. The studies showed that it is possible to use space photography to evaluate the condition of forest areas following forest fires and to calculate the economic impact of forest fires and assist in future planning in forestry work. Figures 1; references 10 (Russian).
[119-9642]

UDC 631.4:629.78

METHODOLOGICAL QUESTIONS OF SPACE STUDIES OF VEGETATION COVER AT VISIBLE WAVELENGTHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83 (manuscript received 22 Sep 82) pp 58-64

ROSS, Yu. K. and YEGOROV, V. V., Institute of Astrophysics and Atmospheric Physics, Estonian SSR Academy of Sciences, Tartu; Institute of Space Research, USSR Academy of Sciences, Moscow

[Abstract] Methodological and technical problems in remote observation of the Earth's vegetation cover from space are reviewed in the context of observations carried out in the visible wavelengths (radar observations are not covered). Theoretical considerations in light conditions, the optical properties of vegetation and soil, and the architecture of vegetation cover are examined: the coefficient of spectral brightness in the soil-vegetation system is variable in space and time and is affected by meteorological, soil and biological factors. Problems in space observations of the vegetation cover include determination of the correlation between optical characteristics and the specific features of the vegetation cover, classifying vegetation, the specific parameters of vegetation in applied problem solving, and the choice of spectral ranges used in observations. Ways of improving information derived from space observations of the vegetation cover are distinguished; increasing the spatial resolution of onboard instruments, using data on the angular dependence of spectral brightness, repeat spectrophotometry of the same objects at different stages in their development, and the use of radiation polarization characteristics. The large number of spectrophotometers now used in this work (about 30) should be reduced and equipment tailored to suit requirements. References 14 (Russian).
[119-9642]

UDC 528.72(202):535.36

ATMOSPHERIC CORRECTION FOR VIDEO IMAGES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 21 May 82) pp 65-75

KOZODEROV, V. V., State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] Two main trends are apparent in the problem of correcting for atmospheric distortion in images obtained from space, namely the theoretical consideration of the patterns in emergent radiation and the practical use of specific models for radiation transfer in the atmosphere. In this paper the author examines ways of solving primal and inverse problems of atmospheric correction of video images based on parametrization of calculation results as a consequence of approximation of dependencies for emergent radiation as a function of photographic conditions and the atmospheric status for an inhomogeneous surface on the Earth. Results are shown from processing of images obtained from "Meteor" system equipment using this approximation. It is shown that it is possible to take into account atmospheric effects in image processing using the mathematical apparatus described, and that this apparatus is more effective than that used by foreign researchers. The usefulness of compiling a catalogue of spectral characteristics for natural formations to be used in conjunction with satellite measurements is discussed. Figures 4; references 39: 28 Russian, 11 Western.
[119-9642]

UDC 551.46:528.7

TRANSFER OF SOLAR RADIATION IN ATMOSPHERE IN PRESENCE OF TRANSLUCENT CLOUD

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 25 Jan 82) pp 76-86

ASMUS, V. V., SPIRDONOV, Yu. G. and TISHCHENKO, A. P., State Scientific Research Center for the Study of Natural Resources, Moscow

[Abstract] The problem of transfer of solar radiation in the Earth's atmosphere in the presence of translucent cloud is of interest both on the purely theoretical plane and in practical ways in order to develop methods for filtering out translucence interference in video data obtained from satellites. The authors propose a method for solving this problem based on expansion of the intensity of solar radiation into a dual progression of multiplicity factors for reflection from an inhomogeneous surface on the Earth and for cloud. The case of a homogenous translucent cloud cover above a homogeneous surface on the Earth is also considered. A model is constructed for the formation of a video signal in the presence of inhomogenous translucent cloud cover over an irregular surface on the Earth using the Green functions and the

Monte-Carlo method in a simplified version. The simplified model can be elaborated as required to take into account factors such as atmospheric scatter and angular dependencies for the coefficients of reflection and transmission in cloud, and so forth. Figures 5; references 7 (Russian).
[119-9642]

UDC 614.841.42:629.78

DETERMINATION OF PHYSICAL CHARACTERISTICS OF FOREST FIRES USING SHF RADIOMETRY

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83 (manuscript received 27 Jul 82) pp 87-94

STAKANKIN, Yu. P.

[Abstract] Proceeding from earlier experimental and theoretical work indicating that the physical characteristics of forest fires as determined from remote SHF radiometry observations can be described from the radio brightness of temperature $T_{br}(Y)$, where Y = (lambda, theta, p) (wavelength, angle of observation and polarization), a mathematical model is built using a variation of the Jacobian matrix in order to analyze the effect of site parameters on the characteristics of $T_{br}(Y)$, and the feasibility of determining the parameters from these characteristics is investigated. The model is described and results of its application are presented. The significance of wavelength on the matrix rank is discussed. It is shown that the site parameters of SHF radiation from forest fires selectively affect the characteristics of luminance temperature and that accurate quantitative values can be found for the physical characteristics if realistic data on the steady-state characteristics of the parameters of the fires are available. Observation conditions required for making determinations of fire parameters are described. The results can be used to develop radiometric methods and select appropriate equipment for remote SHF radiometry observations of forest fires. Figures 6; references 6 (Russian).
[119-9642]

UDC 535.881:535.42

FEATURES OF PHOTOTHERMOPLASTIC MATERIALS USED IN VIDEO DATA SYSTEMS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83 (manuscript received 4 Jan 82) pp 103-108

YERSHOV, Yu. I. and PANASYUK, L. M., Kishinev State University imeni V. I.Lenin

[Abstract] Although the use of photothermoplastic materials to replace silver halide film when recording images of the Earth's surface from space is promising, certain problems nevertheless remain to be resolved, in particular

the relatively low sensitivity of photothermoplastic materials and the unusual nature of recording for different degrees of luminescence, which is effected not by amplitude modulation but phase modulation. Within the framework of theoretical studies being conducted on these materials an analysis is made of some of the features of reproduction of the phase modulated recording employing a coherent source, to determine the correlation between the distribution of intensity in the plane of the image and the parameters of phase irregularities basing the calculations on the Fraunhofer diffraction formulas. Calculations are shown for the case of low density phase irregularities, high density phase irregularities, and average density phase irregularities. The results indicate that when transmitting half-tones it is not advisable to use the full range of densities available in photothermoplastic materials because a critical interval exists in the field of medium densities when images are processed; recording should be limited either to high density or low density deformations depending on the degree of resolution required. References 11 (Russian). [119-9642]

UDC 681.3:528.72

DIGITAL PROCESSING AND ANALYSIS OF MULTIZONAL SATELLITE SCANNER PICTURES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83 (manuscript received 27 Jan 82) pp 109-116

KOLAR, J., Czech Polytechnical Institute, Prague

[Abstract] Studies on the use of results from MSS imagery are described. Using data obtained from a four-channel scan (500-1,100 nanometers), a test section containing 280,000 four-dimensional spectral vectors was analyzed. Initial visual evaluation was done using a 9-level gray-scale with histogram leveling to enhance contrast; the method was shown to be satisfactory. For multispectral analysis of black-and-white images, several classes of subjects were distinguished (water, coniferous forest, deciduous forest, green cover, fields I-III, ground, buildings) each containing a number of image elements (12 to 24). Linear conversion of originals enabled enhancement by reducing dispersion of variables. Total information available in a full data set could be assessed from the magnitude of total variation; details of this analytical procedure are discussed. Methods for color coding of black-and-white images are described and application of the methods is illustrated. Analytical results indicate that machine digital processing of MSS imagery possesses a number of advantages: the digital recording has much greater resolution for gray-scale gradations compared with negative/positive film, enabling 10-15 gradations to be distinguished; and machine processing enables enhancement of each pixel. Figures 3; references 3: 1 Russian, 1 Czech, 1 Western. [119-9642]

UDC 629.783:778.39

EFFECTIVENESS AND MAIN DESIGN PARAMETERS OF ARTIFICIAL EARTH SATELLITES USED FOR CONTINUOUS OBSERVATION OF SPONTANEOUS NATURAL PHENOMENA

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 2, Mar-Apr 83
(manuscript received 4 May 82) pp 117-124

AVDUYEVSKIY, V. S., GRISHIN, S. D., USPENSKIY, G. R., ASTASHKIN, A. A. and SAUL'SKIY, V. K.

[Abstract] An analysis is made of the effectiveness of using satellites for continuous observation of natural phenomena on Earth with a view to minimizing the economic harm resulting from earthquakes, volcanic eruptions, tsunamis, flooding, hurricanes, tornadoes, landslides, forest fires, hail, pests, pollution, avalanches and snow storms. The main tasks of such satellites are to collect experimental data, to detect signs of natural phenomena and determine the rate and direction of spread so that the appropriate administrative organs can be warned, to obtain real time or near real time data enabling continuous monitoring of natural phenomena so that people and property can be protected, and to evaluate the negative consequences from natural phenomena so that effective steps can be taken to eliminate them. In order to carry out these functions satellites should be placed in orbits that enable continuous observation of specific areas on the Earth's surface; the most efficient orbits for this purpose are circular geosynchronous orbits having an inclination of 65° and an orbital period of 24 hours. Equipment aboard the satellites should enable observations over areas 1,000 kilometers square and 2,000 kilometers square with resolution of objects down to 50-20 meters. A mathematical analysis is made of the above design features. Figures 4; references 13: 10 Russian, 3 Western.
[119-9642]

UDC: 502.3+629.78+551+(550(571.1))

USE OF AEROSPACE INFORMATION IN GEOLOGICAL STUDIES OF SIBERIA

Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 2, Feb 83
(manuscript received 16 Jul 82) pp 8-15

ZYAT'KOVA, L. K. and YASHIN, A. L., Institute of Geology and Geophysics, Siberian Branch, USSR Academy of Sciences, Novosibirsk

[Abstract] Aerospace photoinformation is broadly used to study contemporary structures in western Siberia. Two main directions of study are active: development of methods for the use of aerospace materials in structural-geomorphologic studies in order to study contemporary tectonic movement and seismic regionalization; and determination of typical contemporary and seismically active structures of platform and orogenic areas. Various structural forms are determined by combined methods of processing of aerospace photographic information using automated image processing. Using various photograph processing programs, the computer can produce hundreds of photograms with various structural contents reflecting the same initial picture.

This processing of standard reflection characteristics in the contemporary relief of local structures which are promising for oil and gas allows more effective and efficient geological and geophysical prospecting over large areas of little studied regions, particularly the Far North. Deep fault zones are also clearly seen in aerospace photographs in a complex of characteristics which can be realiably recognized and serve as a standard indication of new ore zones. References 14 (Russian).
[123-6508]

UDC 550.814:551.243.8:924.9

CONTORTION OF EARTH'S CRUST FROM SPACE PHOTOGRAPHY DATA AND ITS ASSOCIATION WITH MINERALS IN THE CRUST (USING URALS AS EXAMPLE)

Kiev GEOFIZICHESKIY ZHURNAL in Russian No 3, May-Jun 83
(manuscript received 25 Mar 80) pp 45-52

ALEYNIKOV, A. L., BELLAVIN, O. V., D'YAKONOV, B. P., STREL'NIKOV, S. I. and KHALEVIN, N. I., Institute of Geophysics, USSR Academy of Sciences Urals Scientific Center, Sverdlovsk; USSR Ministry of Geology All-Union Geology Institute, Leningrad

[Abstract] A total of more than 20 pictures of the Earth taken at different times of the year from aboard the "Meteor" system satellites and the U.S. "ESSO" satellites were used to study tectonic contortion of the Earth's crust in the Urals. The pictures were used to compile maps of the lineaments in the area studied, and the arrangement of the lineaments was analyzed with a view to clarifying the association between the lineamental pattern and the presence of minerals. Details of the analysis are shown for the Urals area. It was found that a definite correlation exists between the lineamental arrangement and mineral deposits, which are usually found in zones up to 100 kilometers wide running in virtually the same directions as the lineaments. The greatest concentrations of minerals in the area surveyed were found at points where diagonal zones intersected the meridional belt of the Urals. It is concluded that space photographs can be of use in determining the location of minerals. The most important element in predicting the presence of minerals is isolating the linear zones of heterogenous contortion; within these zones the probability of finding minerals is 5-6 times greater than outside them. Figures 5; references 5 (Russian).
[154-9642]

UDC 551.510.41

SPACE INFRARED SPECTROMETRY AND PROBLEM OF ATMOSPHERIC POLLUTION

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 5, Dec 82
(manuscript received 30 Mar 82) pp 1084-1088

MARKOV, M. N., Physics Institute imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] An ITS-5 infrared spectrometric telescope was installed in the "Salyut-5" orbital station and used October 1976 to April 1977. The measurements were made in directions tangential to the Earth's surface in order to eliminate much of the effect of the planet's outgoing radiation. The author analyzes the results of measurements and finds that they agree quite well with the data available in the literature, with two exceptions: at the higher altitudes, the SO_2 and NH_3 concentrations appear to be greater than those generally accepted by factors of 50 and 10 percent, respectively. If this is true, it is probably the result of the heavier concentration of water vapor in the lower layers of the atmosphere. It would also cause an increase in the greenhouse effect. Figures 3; references 11: 3 Russian, 8 Western.
[77-11746]

SPACE POLICY AND ADMINISTRATION

PRAVDA SCORES U.S. PLANS FOR SPACE-BASED DEFENSIVE SYSTEM

Moscow PRAVDA in Russian 10 May 83 p 5

[Article by A. Tolkunov, correspondent, New York: "A Fraud in Space"]

[Text] Washington's plans to militarize space and create so-called "superweapons for defense" against a nuclear attack have caused serious concern in the United States.

In presenting the decision about the creation of space-based antimissile weaponry as the White House resident's "concern" about "saving mankind" from the nuclear threat, the militaristic circles are clearly attempting to whip the antiwar movement into a white hot fever. The heavy artillery of the military-industrial complex has been brought into play. For example, such an "expert" as E. Teller, "father of the hydrogen bomb," says, applauding the president, "Reagan showed a true understanding of historical perspective. From this will gain not only our children, but also the children of our allies and Soviet children."

The "hawks" on Capitol Hill have also been activated. For instance, that well-known advocate of U.S. nuclear supremacy, Senator M. Wallop of Wyoming, demanded from his colleagues immediate approval, in the legislative order, of the appropriations for the "antimissile superweapons."

However, Senator P. Tsongas of Massachusetts thinks, quite reasonably, that such "concern" about future generations is nothing other than the beginning of a new and extremely dangerous round in the arms race that will place the world on the verge of a nuclear catastrophe. This is why, together with other legislators, he called on the administration to take immediate steps to work out an agreement to prohibit the placement in space of weapons of any kind, for which the Soviet Union is also calling so urgently.

Scientists also have some weighty words to say. In the opinion of the well-known specialists in laser technology, Nobel laureate Ch. Townes, "there is no technical solution to the problem of saving mankind from nuclear weapons." As with many of his colleagues, he sees only one way to eliminate this danger: immediate and constructive arrangements for the limitation and curtailment of strategic weapons and a strengthening of confidence between the two sides. It is precisely in this that the White House does not have an understanding of the historical perspective.

Actually, if we turn to the recent past it is possible to see how the creation of an antimissile defense spurs the development of new offensive strategic systems, as columnist T. Wicker writes in the pages of the NEW YORK TIMES.

This is why, in expressing skepticism toward R. Reagan's "historical initiative," Senator C. Pell declares: "From everything I can see, it looks like we are now falling into exactly the same trap."

It is no accident that the decision to proceed to create "superweapons for defense" coincided with the approach of the date for the placement of American medium-range nuclear weapons in Western Europe. Having place them there, the United States--as some good-for-nothing local strategists like to delude themselves--would gain a significant advantage by the deployment of antimissile systems in space: in just a few minutes the "Pershing-2" will be able to reach the territory of the Soviet Union, whereas the answering attack on the United States' territory would be "neutralized" by the PRO [antimissile defense] system. However, many specialists in the United States assert correctly that the plans for an "absolute" space defense are a deliberate fraud on the American people and a fraud of cosmic proportions. The entire history of weapons shows that a counterweapon will be found for any weapon, just as for any lock there is a skeleton key.

The PRO plans are extremely dangerous for the overall process of negotiations on limiting weapons. As has been mentioned here, the realization of the plans for the creation of "superweapons for defense" would result in a direct violation of the existing Soviet-American Treaty on the Limitation of Antimissile Defense Systems. Article V of this treaty prohibits not only the deployment, but also the development of space-based PRO facilities. In connection with this, President Reagan's declaration that his attempt to stage a revolution in defensive technology will be "compatible with our (American--editor's note) obligations under the PRO treaty," is nothing more than an attempt to delude public opinion and prepare the soil for the disruption of existing agreements.

Many American scientists and specialists in the field of military strategy have arrived at the conclusion that the development of laser military installations for use in space will inevitably undermine the possibility of achieving an understanding in other areas of arms control.

In welcoming this presidential decision, D. Graham, the Pentagon's former chief of intelligence and one of the initiators of the creation of so-called "high frontier"--the program for the deployment of military installations in space--declares in plain terms that it is an attempt on the part of the United States to achieve strategic superiority far above the clouds.

Thus, the idea of creating a PRO, which is attractive to uninitiated people at first glance, in essence conceals the intention of transferring the arms race to space and from there to threaten mankind. This idea is totally permeated by the United States' aspirations to achieve military supremacy over the USSR. In connection with this, the leaders in Washington do not reject the augmentation of strategic offensive weapons. President Reagan approved the recommendations of the Scowcroft Commission, which call for the immediate deployment of 100 "MX" missiles and "Trident" and "Trident-2" missile systems in submarines, as well as the creation of the new "Midgetman" mobile intercontinental missile. The plans for strengthening the United

States' nuclear potential encompass the period from right now to the 1990's. In other words, they will basically be realized at just that time when Washington proposes the creation of an effective PRO system.

The United States' intention to acquire a nuclear "spear" along with its antimissile "shield" has only one object: to deprive the other side of the capability of inflicting a responsive nuclear blow and to disarm the Soviet Union in the face of the American military threat. This would not only open the door to nuclear blackmail on the part of Washington, but would also lead to an unrestrained race for all types of strategic weapons, both offensive and defensive.

Such militaristic plans, warns Professor of Physics H. Bethe--one of the signers of the American scientists' appeal to Yu.V. Andropov--will lead not only to the final blow to the two sides' faith in each other, but also to a sharp increase in the risk of military conflict, which could escalate into a nuclear holocaust. Washington will bear the responsibility for this. This means that the American president will not grant children a "peaceful future," but the greatest anxiety.

Professor Howard Parsons, of Bridgeport University, called the concept of the possibility of protection against a nuclear attack, as advanced by the United States' administration, absurd and dangerous. If such a system is actually introduced, the professor thinks that it will make any serious negotiations on disarmament impossible. Yu.V. Andropov's proposal for the organization of a meeting between American and Soviet scientists at which they could discuss the possible consequences of the creation of a large-scale antimissile defense is, in Parsons' opinion, reasonable and realistic. This proposal, he thinks, must be studied carefully by the American administration.

11746
CSO: 1866/126

LAUNCH TABLE

LIST OF RECENT SOVIET SPACE LAUNCHES

Moscow TASS in English or Russian various dates

[Summary]

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
23 Jun 83	Cosmos-1470	680 km	645 km	97.8 min	82.5°
27 Jun 83	Soyuz T-9	(commander: Vladimir Lyakhov; flight-engineer Aleksandr Alekxandrov)			
28 Jun 83	Cosmos-1471	369 km	182 km	89.7 min	67.2°
1 Jul 83	Prognoz-9	720,000 km	380 km	26.7 days	65.5°
		(Research on background radiation, X-rays and gamma bursts; solar radiation, plasma and magnetic field studies; carries equipment made in USSR, Czechoslovakia and France)			
1 Jul 83	Gorizont	36,600 km	--	24 hrs 39 min	1.3°
		("For further development of communication and television broadcast systems using earth satellites"; near-stationary, circular orbit)			
5 Jul 83	Cosmos-1472	264 km	197 km	88.8 min	82.4°
		(For earth resources studies)			
6 Jul 83	Cosmos-1473--Cosmos-1480	1,511 km	1,448 km	115.1 min	74°
		(Eight satellites launched by single booster)			
8 Jul 83	Cosmos-1481	40,165 km	615 km	11 hrs 58 min	62.8°
13 Jul 83	Cosmos-1482	376 km	217 km	90.2 min	70°
		(For earch resources studies)			

Date	Designation	Orbital Parameters			
		Apogee	Perigee	Period	Inclination
19 Jul 83	Molniya-1	39,025 km	480 km	11 hrs 40 min	62.9°
		(Communications satellite for telephone and telegraph communication and transmission of USSR Central Television to areas in the "Orbita" network)			
20 Jul 83	Cosmos-1483	305 km	227 km	89.5 min	82.3°
		(For earth resources studies)			

CSO: 1866/170-P

- END -